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Design, Construction, Operation and Maintenance of all Public Works

CURSE OF THE CONTRACTING BUSINESS

The contracting business is sorely afflicted with a custom. This custom is a blight, a killing frost, a curse. In parliamentary language this troublesome agency is called the low bid. The low bid is one of our cherished institutions. It is lovely in theory. In practice it is as a monkey wrench hurled into the machinery of construction. Everything would be lovely if it were not for the fact that a fool is born every minute and that an amazing number of them horn into the contracting business. Knowing nothing whatsoever about costs they keep bidding until they are decidedly low on some job. Owing to the prevailing willingness of city officials to sting the contractor on occasion, the ridiculously low bidder is awarded the job. Lacking experience and an organization he is soon head over heels in a dozen kinds of grief. He throws up the job or stays on and goes broke. This makes for poor construction, delays completion, increases costs and balls things up generally. Meanwhile the responsible bidders are looking for other jobs, occasionally winning out, of course, at a fair price, but being often thwarted by the irresponsible low bidder. There is generally at least one such bidder at every letting.

Isn't it about time for engineers to come to the rescue of contractors in this connection? For humane reasons why not save the irresponsible bidder from his ignorance and folly? He is a good man, as often as not, but is out of his element. With credit at the bank and an inclination towards contracting, and a desire to win the supposedly large profits in the business, he takes a flier in the construction business and speedily goes broke. Let engineers warn their employers against the irresponsible bidder. Let engineers explain that it never pays to underpay a contractor. The owner invariably suffers when an attempt is made to gouge the contractor, especially a contractor who is incompetent, inexperienced and not any too strong financially.

TO SAVE MONEY BUILD NOW

There is a disposition in some quarters to postpone constructional activities until after peace has been restored. Undoubtedly this tendency rests upon the assumption that with the return of peace there will be an immediate return to ante-bellum conditions with reference to the cost of labor and material. We are convinced that this view is fallacious, for the specific reasons here set forth. At the outset too much emphasis cannot be placed upon the fact that considerations of narrow self-interest quite as much as those of broad and enlightened self-interest, commonly called patriotism, indicate the desirability of going on with building now.

Not only should plans be laid for a full program of construction next season but the present construction season should be continued as long as the weather will permit. From present indications conditions affecting the prospective builder are less onerous now than they are likely to be next year.

The United States seems definitely embarked upon a program of uplifting and upbuilding the world. This program has the approval of the vast majority of the people and of the leading political parties; therefore it is likely to remain in effect indefinitely. This will mean a greater demand for American labor of all sorts, at home and abroad, and a correspondingly greater demand for materials than the country has previously known. This greater demand for labor and material will continue after the war and will work greater hardship on the individual buyer then than now, for price regulation is likely to end with the war.

Scarcely a day passes but we are reminded of great building operations contemplated for Russia, France, Belgium and Poland at the close of the war. American engineers and contractors and American materials will figure heavily in these titanic labors of new and reconstruction. It is evident that this will boost prices in this country. In China and South America materials and men from this country will shortly be in greater demand than ever before.

In a previous issue we pointed out the various conditions which will continue to make for a labor shortage for an indefinite period.

Economists, generally, believe that there will be no drop in costs of labor and material for years following the end of the war. The restoration of destroyed merchant shipping and the upbuilding of the great American mercantile marine will impose heavy demands on labor and material alike. Coincident with and because of the expansion of foreign trade there will also come increased domestic demands for labor and materials.

American railways have been curtailing construction of all sorts for years and must soon engage in heavy building programs, however desirable inaction in this line may be as a background for demanding rate increases, war has taught us more of the economic and military importance of improved roads than we knew before, so road building is likely to go forward on an ever increasing scale. There is strong probability also of a partial return to water transportation which will call for new canals and much stream improvement.

We must revise our ideas relative to costs. We must become reconciled to higher labor and material costs. Those in the American public works field might conceivably stop building but the demand for construction materials and labor from other quarters would continue and would keep prices up so that when public works construction was resumed prices would be higher than when it was discontinued. Moreover, postponement cannot be continued indefinitely and depreciation is going on all the time. There is nothing to be gained by waiting to see now and when the war will turn out before going on with public works construction. On the other hand, there is much money to be saved by going on with vigorous construction programs now.

GET A FRESH START NOW

For fully fifteen years engineers have considered their profession overcrowded and have severely criticised the officers of engineering schools for advertising that engineers were in demand. Now all is changed. Employers of engineers state that it is hard to get men, and engineers are urging the schools to go out after all the engineering students they can get. Opportunity has again become the engineer's middle name. Now it so happens that during the aforementioned fifteen years we have heard a lot about square pegs in round holes—about misfit engineers. Isn't this the best time ever for the engineer to recast his business affairs a little nearer to his heart's desire?

CARELESS BIDDING

The beneficient Providence that is said to watch over the destinies of fools doesn't always protect the contractor who forgets to add the cost of material to the cost of labor in determining the amount of his bid. Occasionally, perhaps usually, a contractor who submits a ridiculously low bid is let off comparatively easy as a result of a frank confession of error. But if the body who receives the bid has no more Christian charity than George Peck's well-known tannery, the contractor finds he has let himself in for a lot of trouble.

Several cases of careless bidding have recently been reported. The board of public works of a large western city recently awarded a sewer contract to the low bidder in spite of his protestations that he had made a mistake of $10,000 in totaling up his bid. He told the board that there was a clerical error in his bid of $35,609, and that he meant to place the figures at $45,609. His original bid, as submitted, was $10,833 lower than the next lowest, and if the board had allowed him to alter it as he requested, he would still have been the low bidder. However, it was the opinion of the board that it had no legal right to recognize the contractor's claim that an error had been made, and its only course was to award him the contract upon his original bid. The engineer's estimate was $44,000.

A southern city has just sued a bridge contractor for $50,000 damages because of his failure to stand by his bid of $434,400 to build a 2,500-ft. concrete bridge across the Arkansas river. The contractor claimed he made errors in his bid and therefore withdrew it. He said he intended bidding $493,598 instead of $434,400.

Another contractor found himself in embarrassing circumstances because he bid $4,477.90 per lineal foot for constructing a sewer when he was not only willing, but anxious, to take the entire job at that figure. This was one major item on a $200,000 job. As he was low bidder, when the sum named was taken to cover the job, it is thought he will get the contract.

Other evidences of carelessness in submitting bids on public works construction could be cited, but these are sufficient. The penalty for errors of this sort is heavy. In the first case cited,for example, the bidder's mistake will cost him a round $10,000. It is hard to tell how the second man will come out in his $50,000 damage suit, but he can't get the best of it, that's sure. The third man had only the job to lose, but as it was a $200,000 contract he was bidding for, that was something to lose, assuming, of course, that his bid was safe as corrected.

Bids of the sort mentioned have the smack of too much conviviality. Contractors should submit their bids before sitting in at the poker game, not afterwards.

Of course, contractors will make mistakes, but these should be rigidly excluded from bids. Mistakes in judgment will influence the bids of the most careful, but a clerical error in a bid is ample evidence that the contractor is only one hop ahead of the fast-going fool catcher.

THE CONTRACTOR AND PUBLICITY

When it comes to modesty the violet has little, if anything, on the contractor. The contractor is obliging enough, and if cornered by an editor will disgorge all kinds of much wanted information. His native desire to do something for the other fellow prompts him to take this action. But when the suggestion is made that he go in for a little publicity on his own account he blushes, twirls his hat, and begs to be excused. This is unfortunate—for the contractor and the public alike.

The public needs to know the modern contractor better than it does, and he needs to be better known than he is. There have been enough graft stories printed in newspapers, involving public officials and public works contractors, to give the average misinformed citizen the impression that the contractor is "a slick fellow who will bear watching." That this is a grossly unjust attitude need not be argued here.

If that is the popular conception of the contractor, and there seems good reason for thinking that it is, what can he do to change the popular attitude towards the contracting business?

An answer to this query is found in some publicity work recently carried on by Chicago paving contractors. These men have conducted an advertising campaign, which had for its object the upbuilding of popular confidence in the paving work done by this city and in the contractors themselves as responsible business men. Something of the sort was clearly needed in this locality to offset the left-handed advertising paving contractors have had on several occasions in recent years. Many people, with the best of intentions to be just and fair, had obtained the impression from an occasional newspaper story that Chicago pavements are lean in quantity and poor in quality.

An important incidental aim of the campaign was to arouse the interest of the people in street paving in general. This interest, aroused, would naturally lead to more pavement construction, calling, of course, for the services of the paving contractor. This is merely the familiar form of commercial advertising adapted to the contractor's needs.

The background against which the campaign was projected was the general principle that a pavement contractor is a man with service to sell. The taxpayers are his customers, and it is not only desirable, but requisite, that they should know of him and have confidence in his work. In a big city the individual taxpayer has small opportunity to know the contractor personally and meets only his subordinates. In such cities the contractors will do well to advertise when the occasion is appropriate. A little judicious newspaper advertising will also gain the good will of the newspapers. Certainly no one could doubt the value of this.

In many ways the contractor should come out of his self-imposed exile. He should be more active in conventions and he should write vastly more than he does for the technical and popular press. He should learn that it pays to advertise.

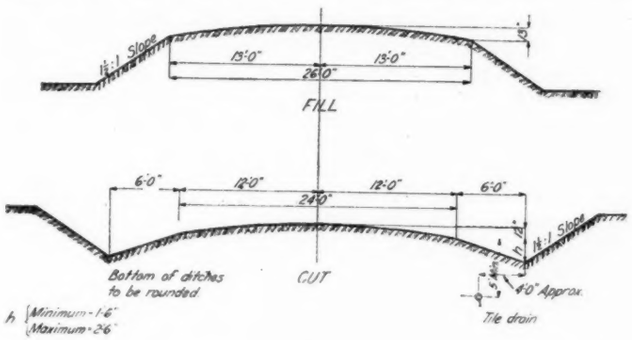
Outstanding Features of the Work of Various State Highway Departments This Season

THIS has been an important year in state highway construction, and this resume of the outstanding features of the work in various departments is based on the editor's correspondence with department officials.

—Iowa—

Under date of September 5, J. W. Eichinger, bulletin editor of the Iowa State Highway Commission, Ames, wrote as follows relative to the salient features of Iowa road dseign, construction and maintenance during 1917:

The most outstanding feature of the construction work, as it appears to us at the present time, is the comparatively higher class of work which counties are securing this season.



STANDARD CROSS-SECTIONS FOR EARTH ROADS, COUNTY ROAD SYSTEM SERIES OF 1917, IOWA STATE HIGHWAY COMMISSION.

This is due largely to four years of education on the part of both the highway commission and county engineers. Road foremen understand to-day far better than they did four years ago, when present road laws became effective, the building of roads according to blueprints. Viewing the results of their work from year to year, they have been learning more fully each season how much more satisfactory it is to do a creditable piece of work than to do the old-fashioned slipshod type. The better class of men are learning to take pride in their work. Foremen are now able to secure and keep a better trained class of workmen than they could in the past. This means a great deal in securing good work.

Engineers are also becoming far more insistent on contractors and foremen leaving better finished and more workmanlike jobs than formerly. A few county engineers have it in their contract agreement that after a job has been practically completed, it be allowed to pack and settle for a time, when new shoulder lines shall be run by the engineer and the contractor give the job a final trimming up before final acceptance. A higher class of work, better and more perfectly finished to both grade line and cross-section, is, in our opinion, the most outstanding feature of road construction in Iowa this season.

As for maintenance, the establishment of a compulsory patrol system over the entire county road system undoubtedly will mean much ultimately for Iowa road maintenance. Each patrolman is to give his entire time to a definite section of road and be entirely responsible for dragging and all maintenance features. The law did not become effective until July 4, after all counties had their plans and appropriations made for the season, so that it has not been very effectively in operation this season. Several counties, however, have had the system in use several seasons of course, with very gratifying results.

As for design, there has been no change in the Iowa standard cross-sections in any way in the past four years. These standards were adopted at that time after some ten years' study and experimentation in road design under soil and climatic conditions as they prevail in Iowa.

Herewith is illustrated our standard cross-section for cut and fill on the county road system of the state, which comprises some 17,000 miles of the more important highways, connecting up county seats and market places. The standard cross-section for the township road system of lesser roads, of which there are some 85,000 miles, is identical except 4 ft. narrower in width. Taking 4 ft. out of the center of the section leaves the section perfect for the township standard.

The cross-section on fill calls for a width of 26 ft., shoulder to shoulder, with a crown of 13 in. in the center, a slope of an inch to the foot. The standard side slope is 1½ to 1. The cross-section in cut calls for a shoulder-to-shoulder width of 24 ft., with a crown of 12 ft. Standard back slope of side ditch is 1½ to 1. Distance from shoulder to center of ditch is 6 ft., with depth varying from minimum of 1 ft. 6 in. to 2 ft. 6 in.

The standard Iowa cross-section has been criticised as being too heavy. Engineers have insisted that the ditch is of unreasonably large size. The results of four years of statewide experience amply justify the present standard design in every way. No change has been made and none is deemed likely to be made.

The Iowa cross-section is designed to produce a dirt road that will last and bear the traffic and weather conditions to which it is subjected for a considerable period of years, with the lowest possible maintenance cost. Iowa is to-day building almost no surfaced roadways. She has 104,000 miles of road, almost every mile of which must be kept in usable condition, for almost every quarter section of Iowa land is a productive farm and must have its market road. The extent of the mileage makes it impossible that any considerable percentage of the roads be surfaced in the near future. Road builders are confident, however, that Iowa will make rapid progress in actually paving her important highways when she does start, and have designed the Iowa standard with the view of not only giving service now as a dirt road, but of supplying the best possible foundation without rebuilding for the paved surface when the time comes to put it on. Packing and settling under traffic and weather conditions for a period of years, together with careful patrol maintenance during this period, should produce the best foundation for hard surfacing it is possible to build out of dirt. It is manifestly impossible to secure as satisfactory and substantial a foundation out of new construction.

The cross-section has been planned for economical construction. The perfect cross-section can be shaped up with tractor and blade grader. Ordinary maintenance methods can accommodate the cross-section to varying qualities of soil. Some sections of the state will stand a flatter crown than others. Road draggers reverse the drags from time to time in these districts and throw the dirt to the outer edges instead of the center. If a higher crown is necessary, draggers continue to throw the dirt toward the center.

The width of the cross-section has been determined with a view of meeting traffic conditions, as they can be easily foreseen for the near future, not alone for the needs of to-day. The narrow road grade that was ample for the slow-moving horse traffic, experience to-day is showing to be utterly inadequate for the fast-moving motor vehicle traffic. A traffic census in progress to-day shows that on some roads the motor freight traffic almost equals the horse freight traffic. Conditions in the next four or five years can be readily foreseen.

The Iowa standard gives ample roadway for three fast-moving vehicles to pass, with a good large zone of safety for dirt road conditions between.

The side ditches are designed to be built with the tractor and blade grader. They are of sufficient size to prevent their being readily filled and clogged up. They can be cleaned and rebuilt with tractor and grader when such action becomes necessary, at comparatively low cost. In addition, the counties are putting in thousands of yards of tile underdrainage, where conditions warrant this expenditure. The location of the drain is shown on the cross-section drawing.

In addition to the permanent grading work, topography of a great many counties is such that thousands of miles of road are being built with blade graders alone, putting the road to standard cross-section, but to natural grade. This permits of a large mileage of improved road at comparatively low construction cost. The commission limits the amount of money that may be spent on this type of construction, however, to

VIEW OF BITUMINOUS MACADAM ROAD BUILT BY PENETRATION METHOD, WAYNESBORO, VA.

$60 per mile. If the estimate shows the expense of construction to be over this figure, complete surveys for a permanent grade, plans and profile must be made and approved by the commission before the work is allowed to proceed.

—Virginia—

C. B. Scott, assistant commissioner of highways of Virginia, Richmond, writes:

The most noticeable advance in road improvement in this state during the last year is the inauguration of a system of state aid for maintenance for public highways constructed with state aid or county bond issues. That law went into effect June 17, 1916, but practically no funds were available to carry on the work until January 1, 1917. The state automobile tax, amounting this year to something like $475,000, is thus set aside for maintenance. The money is appropriated to the several counties according to the amount paid into the state treasury in general taxes, and the counties are required to put up an equal amount to that received from the state, thus making a joint fund double the amount of the automobile tax.

Heretofore the state aid roads, when constructed, were turned over to the local road authorities for maintenance, and as they were superior to the unimproved public highways they were generally neglected until in many cases the surfacing was practically worn off. This was also the case with county bond issue roads, and was a most unbusinesslike policy, where bonds were being issued for road improvement and the roads were being allowed to go to pieces long before the bonds were paid.

The accompanying view shows a macadam road built this season.

—North Carolina—

W. S. Fallis, state highway engineer of North Carolina, Raleigh, writes as follows of his work this season:

Our commission is this year organizing for the maintenance of a system of state highways as provided by our last legislature. These highways will be maintained in whatever condition we find them and in whatever condition the counties arrange to construct, or in whatever condition they are placed by the Federal aid road fund.

We are dividing the state into divisions, putting maintenance engineers in each division, with a chief of maintenance engineer to supervise the work generally. This work will be carried on in the main by the patrol system, using a patrolman for each section, taking care of the work in that particular division. The patrolman is responsible to the division engineer; the division engineer is responsible to the maintenance engineer, and the maintenance engineer is responsible to the state highway engineer.

We expect to arrange this system of maintenance on thru roads only—that is, roads connecting county seat with county seat—and we hope to keep all these roads in passable condition through the entire year. Many of these roads are in excellent condition, and we have one stretch of 400 miles that we hope to have within the next 18 months so it will be open for the entire year for automobile travel. Many sections of this road will be of the highest class, while others will be of sand-clay gravel. We hope to have the entire mileage of sand-clay gravel, brick or bituminous material within the next 18 months, with no grade in the 400 miles exceeding 4½ per cent.

We expect also to have two roads running north and south thru the state in the same condition, and we will, so far as may be necessary, concentrate our maintenance efforts on these roads.

—Texas—

Julian Montgomery, chief office engineer, Texas State Highway Department, Austin, writes that the department was organized only a couple of months ago. No construction has as yet been undertaken, and the question of maintenance is, of course, in the future. The designs are practically complete, but have not yet been finally approved.

—Nebraska—

Geo. E. Johnson, state engineer of irrigation, highways and drainage of Nebraska, Lincoln, writes:

As it is necessary to lay out some 4,000 miles of roads, connecting our county seats, before starting any construction work with state and federal money, we have been unable to award any contracts this season.

These roads are all located now, with the exception of four counties, and we expect to have the location of the system completed within the next ten days, get our projects approved by the government, and be in position to award contracts by the 20th of January. We will start on nineteen different projects, and expect to spend $1,250,000 in the year 1918.

—Delaware—

Charles Upham, chief engineer, Delaware State Highway Department, Dover, writes that the department has been organized only two months, and is at present busy in preparing specifications, standards, etc. He hopes that by the spring of 1918 he will have at least 100 miles of surveys completed and be in position to construct as many miles as the Highway Commission deem advisable. His plans and specifications will conform with the suggestions and standards of the United States Government for Federal Aid Projects.

—Oklahoma—

Max L. Cunningham, state engineer of Oklahoma City, writes:

"Owing to the fact that 1916 was election year and this

office has less control than we should have of county expenditures, there has been practically no work done during the portion of 1917 just passed, and that our working season really begins about October and our best work is done during the winter months, we are unable to state definitely what we will accomplish owing to the fact that many of the counties have not yet completed their tax levies, and we cannot tell what funds will be available."

—Nevada—

Nevada recently created a State Highway Department. R. K. West is state highway engineer, Carson City.

—Mississippi—

Xavier A. Kramer, Mississippi state highway engineer, Jackson, submits the following information relative to road work in that state:

The Mississippi state highway department is a new department, as it has only been in existence about a year, and, as is usually the case with a new department, a very small appropriation was made, so naturally it has been handicapped. The department has recommended a system of connected highways through the state and has a large portion either completed, under construction or being promoted. When these roads are completed, Mississippi will have one of the best system of highways in the south.

VIEW OF A MISSISSIPPI GRAVEL ROAD.

Various types of roads have been built, but on account of the deposit of a good grade of sand-clay-gravel in a number of the counties in the state, gravel surfaced roads have been constructed in a larger portion of the state. This local gravel is usually put upon the road as it comes out of the pit, however, in some instances it becomes necessary to mix a small percentage of clay with it in order to make it bind properly. The sub-grade is cut and rolled as in ordinary macadam roads with proper earth shoulders to keep the gravel from washing off the road. The gravel is then spread in a uniform depth of 8 ins. on the sub-grade and rolled with a roller weighing from 5 to 10 tons. After the gravel has been rolled, it is necessary to shape up the gravel for a few weeks after each rain until it is properly set up, after which it presents a smooth, hard surfaced road that holds up well under ordinary traffic, and with proper maintenance will last for several years without resurfacing. A view of a Mississippi gravel road is shown herewith.

On the more important and extensively traveled roads a superficial surface treatment of "Tarvia," asphaltic tar, or light road oil, is applied which gives a dustless road and increases the life of the road.

In localities where rock is convenient, it is crushed to a 3-in. size and put on the road as a base, 8 ins. in depth, and then covered with a 3-in. layer of sand-clay-gravel, which, after being compacted, makes a very serviceable hard surfaced road.

In counties where gravel and rock are not convenient and freight rates on surfacing material is prohibitive, a surfacing of sand-clay is used. This makes a good, serviceable road for light traffic.

In the poorer counties where funds are limited, roads are graded and drained, which is a great improvement over the ordinary Mississippi roads. At some future time when funds become available, a hard surfacing can be applied without any loss of the previous work.

In Lee county several miles of concrete roads with gravel shoulders have been built. This makes a much more permanent road and reduces the maintenance costs.

Various methods of road maintenance are in vogue in different parts of the state. Some counties let their improved roads out to a responsible road contractor for a fixed amount per mile per year, while others use a competent road superintendent with teams and labor to keep their roads in proper repair. In a few instances the counties have purchased motor trucks to do all of their hauling, dragging, machining, etc. This has proved to be a very cheap and satisfactory manner of road maintenance, as it enables them to cover their whole road system in an efficient and satisfactory manner.

Herewith is an approximate cost of the various types of road construction in the state:

Type of Road	Cost Per Mile
Graded and drained roads	$ 500 to $1,000
Sand-clay roads	1,200 to 1,800
Gravel roads	1,800 to 4,500
Gravel roads with superficial coat oil, etc.	2,200 to 5,000
Concrete roads	9,000

—Illinois—

W. W. Marr, chief highway engineer, division of highways, department of public works and buildings, Springfield, writes:

The construction of state aid roads in Illinois has followed closely standard specifications and well-established practice. On account of increased prices of road material and labor, attention has been directed in the way of drainage and grading earth roads to a permanent grade line.

There is still considerable enthusiasm in this state for oiled earth roads. Nearly every county in the state has oiled a few roads. The high price of road oil and the difficulty experienced in getting shipments have retarded the work somewhat. It is estimated that 4,000 or 5,000 miles of earth roads have been oiled this year by townships, counties and the state.

There have been completed this year more than 100 miles of hard surfaced state aid roads. Approximately 70 per cent of the work has been of concrete, 10 per cent brick and 20 per cent of other types such as gravel, macadam and bituminous roads.

The chief deviation from standard practice in concrete road construction has been the elimination of all transverse joints. Approximately 90 per cent of all contractors on concrete road construction are now using the belt finish in preference to hard floating. About 10 per cent of the contractors are using the light hand roller on the soft concrete preparatory to the belt finish. It is hoped that all contractors will use the roller for compacting the concrete and the belt for finishing the pavement by next year, as it is very evident that better results are obtained.

On brick road construction our specifications require the monolithic or semi-monolithic type. There seems to be a preference for the true-monolithic, that is, where the bricks are laid upon the soft concrete base. The semi-monolithic, that is, laying the brick upon a dry sand cement cushion, is used only where conditions indicate that such construction will be more practical or economical.

The chief maintenance work in this state has been to fill almost exclusively in maintenance work. The truck carries a all cracks and joints in concrete and brick pavements, apply bituminous surfaces to gravel, waterbound macadam and bitmuminous roads. The small Ford auto truck is used heating kettle and all small tools necessary to attend to the maintenance on the average job. Such equipment has proved to be very satisfactory for filling cracks and joints in brick and concrete pavements.

—South Dakota—

Homer M. Derr, secretary of the South Dakota state highway commission, Pierre, writes that the commission is just now getting organized, and plans and specifications have not as yet been drawn or any road work whatever been done under the auspices of the commission. He goes on to say: "The law establishing this commission did not go into effect until July 1, 1917, and circumstances have been such that it has been almost impossible for the chairman to have official meetings to transact business. We are just now very busy in making out a five-year program for state work on which there will be available $1,214,190.30 federal aid, and our legislature has appropriated $250,000 for road work the first two years, which latter is intended to match dollar for dollar the federal aid the first two years, and to cover all necessary office expenses and expenses for engineering services in the field, including the salary of the highway engineer. We have not as yet been able to even formulate our first project statement, but hope to be in a position to do so quite soon."

—West Virginia—

A. Dennis Williams, engineer, chairman West Virginia state road commission, Charleston, gives us this review of the work of the commission:

The West Virginia state road commission was created by act of the legislature 1917. The new commission consists of T. S. Scanlon, secretary-treasurer, and A. D. Williams, chairman. They were appointed and assumed duties June 1. The commission has charge of the collection and disbursement of the automobile tax, the regulation of traffic upon the public highways and the establishment, location and general supervision and construction of the Class A or main county roads in conjunction with the county courts.

Since 1912 there has been voted $17,291,000 for road improvement in West Virginia. Under the new law, the levies provided are 25c for the Class A or main county roads upon all taxable property in each county, or so much thereof as the courts may lay, and in addition a 15c special district levy. To this can be added two special emergency levies in case of flood or other destruction to roads or bridges.

The state road system, comprising approximately 4,600 miles of road, has been about completed in location. This mileage will be within one mile of 80 per cent of the people of the state, no section of the state will be over 12 miles from a Class A road. This system will connect all of our important towns and county seats.

Up to date we have 28,500 automobile licenses issued. For the fiscal year 1905 there were 176 automobile licenses issued in the state of West Virginia.

Standard designs of bridges, culverts and specifications are being prepared for publication. For the coming year efforts will be made to get the state system of roads graded, ditched and drained, but until prices of material and transportation conditions change our policy will be to expend our funds and energy in this direction, using, of course, local materials wherever practical and possible.

—Indiana—

William S. Moore, engineer of the Indiana state highway commission, Indianapolis, writes as follows:

The new Indiana state highway commission consists of four members: Mr. L. H. Wright, chairman, Mr. Haines Egbert, Mr. D. C. Jenkins and Mr. Lewis Taylor. This commission is what might be called a continuing commission—there is one member appointed for four years, one for three years, one for two years and one for one year. After that all members will be appointed for the term of four years.

William S. Moore has been appointed state highway engineer and is also by virtue of his office secretary of the commission. The commission is provided with state funds and will also have charge of all federal aid money.

It is the present intention of the commission to designate about four roads, one passing through the center part of the state from north to south, starting at South Bend through Indianapolis to New Albany; one road across the northern portion of the state, which is commonly known as the Lincoln Highway, passing through Fort Wayne, South Bend and Valparaiso, and one road passing through the center, commonly known as the "Old National Road" starting at Richmond through Indianapolis to Terre Haute. The road across the southern part of the state has not been definitely decided upon, but will probably start at Lawrenceburg and terminate at Evansville. These four roads will be approximately 800 miles long.

The commission expects to put all of next year's state and federal money on the improvement of these roads, and later on additional mileage will be laid out up to the 2,000 miles, which is all the commission has authority to lay out before January 1, 1920.

Large Rustic Swimming Pools Constructed at Small Cost

The West Chicago Park Commissioners have under construction in Columbus Park two swimming pools that present features of interest, both on account of the large size of the

VIEWS ON CONSTRUCTION OF CHICAGO PARK SWIMMING POOLS OF UNIQUE DESIGN.

pools and the remarkably pleasing rustic appearance attained at comparatively low cost.

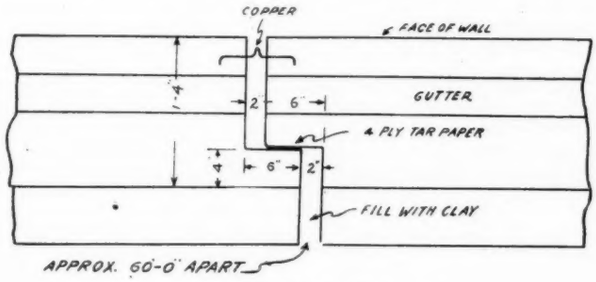
Design

Columbus Park is a new park, comprising about 145 acres, located in the extreme west central part of the city, and has been under construction for about two years. The pools are

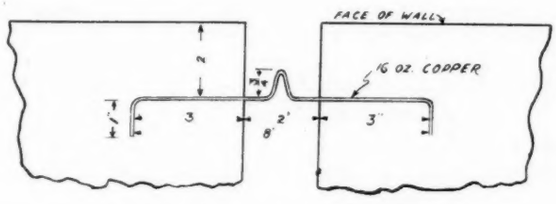
near the eastern side of the park and are of irregular circular design to meet the conditions of the location and give them a more natural appearance. The larger pool is designed for a water depth at one end of 3 ft., sloping to 4½ ft. at the other, has an area of 23,430 sq. ft. and is formed by arcs of 13 points of tangent. The smaller pool is designed for a water depth of 8 ft. at one side, sloping to 9 ft. at the other, has an area of 7,280 sq. ft. and is formed from the acrs of 6 points of tangent. The entire floors and side-walls of both pools are made of 1:3:5 concrete, except that the floors are faced with one inch of 1 to 1 concrete. The walls will be capped with natural rock flagging, which will be carried back to form ledges and diving platforms, and at the side of the smaller pool will be a rock ledge ravine through which water from an artificial spring will flow into the pool. The entire surrounding area will be graded and planted with trees and shrubbery with the view of giving greatest naturalness to the appearance of the pools and landscape.

Structural Features

The structural features of greatest interest are the expansion joints in floors and side walls. The floors were laid in 30-ft. slabs extending across the pools with 5 ft. square marked joints, the slabs being laid alternately to provide for contraction. Between the slabs extending across the pools are 1-inch expansion joints and 2-inch expansion joints are carried entirely around the floors of the pools immediately adjoining the side-walls. These joints are packed with oakum to within 2 in. of the surface and the remaining space filled with tar. The side-walls are 6 to 12 ft. high, with 16-in. tops, 3 ft. to 3 ft. 6 in. footings, have 1 in 10 in. batters, and are provided with slip expansion joints. These joints provide for a 2-in. expansion and are spaced about 60 ft. apart in the walls. About 2 in. from the inner face of the walls in the expansion joints is a sheet of 16 oz. copper extending from the top to



DETAIL OF SLIP JOINT



DETAIL OF COPPER EXPANSION JOINT

DETAILS OF SLIP AND EXPANSION JOINTS.

the bottom of the wall. This copper sheet is crimped in the center to provide for expansion and bent back at right angles at the sides to form anchorages in the walls. The overlapping concrete faces of the slip joints are separated by four-ply tar paper. These joints were made by using taper forms and pulling the forms after the concrete had set but before it had become entirely dry.

At about 30 ft. distances around the top of the side-walls leading from a recessed inlet extending half the distance thru the wall are 4-in. cast-iron overflow pipes fitted with strainers. Each pool has a 6-in. water supply pipe and a 12-in. outlet drain. It is proposed to renew about 20 per cent. of the water every night and once each week the pools will be completely drained and the floors and side-walls scrubbed with an acid solution.

The contract for the excavation and concrete work of the two pools was let March 27, 1917, to J. J. Croake & Co., 2929 Fullerton avenue, Chicago, for $15,691. Material for the concrete was delivered in motor trucks to the most convenient locations for rapid work surrounding the pools, and all mixing was done in a 1/3-yd. "The Standard" Low Charging Mixer, the portability of which permitted it to be quickly moved along as the work progressed, reducing the wheeling of material and concrete to the minimum.

This is the thirteenth park the West Chicago Park Commissioners have equipped with swimming pools, the design and construction of which have been under the direct supervision of Mr. A. C. Schrader, chief engineer. Plans for swimming pools in two other parks are now in preparation. During 1916 the pools of ten of these parks were in service and were patronized by 877,232 men and 375,075 woman bathers.

Getting Action on Long-Delayed Street Widening Job

The widening of Twelfth street, Chicago, is one of the projects Chicagoans have read much about in recent years. To many persons this project had come to be almost as elusive as the construction of passenger subways, the construction of the "boulevard link," the electrification of the Illinois Central terminal lines, the development of the lake front parking program and other much-wanted improvements which were said to be on the way yet never seemed to arrive. That the dirt has been flying on the Twelfth street job recently, however, can be seen from the accompanying views.

This job was held up by people owning property along the portion of the street that was marked for widening. Of course most of the owners of abutting property favored the improvement, but there were enough of contrary mind to "hang the jury" for a good while. M. J. Faherty, president of the board of local improvements, forced the cases to trial and got the property condemned. He also had the state legislature pass an amendment to the Illinois local improvement act, which is so full of checks and balances that it makes it almost impossible for a city to get anywhere with anything, to allow the board to borrow 50 per cent of the amount of the assessment levied to defray the cost of the improvement, to be paid back when collected, so that the board could immediately pay the awards for the property condemned. Mr. Faherty then started the condemnation proceedings and then built new sidewalks and pavements and these were paid for in the usual manner by special assessment funds.

Mr. Faherty has been out on the job every day since August 1, 1916. As soon as the city got possession of the property 200 buildings were moved back in less than six months. All frame buildings were destroyed. Brick buildings were moved back bodily or cut off and given a new front. These new fronts add greatly to the appearance of the street. Each property owner made his own contract for the requisite physical changes. Three buildings were destroyed where the board was unable to settle with the owners at a generous price —this is vacant property now.

This work first came up for a public hearing four years ago. It is a part of the Burnham plan for the new city of Chicago. The widening will extend from Michigan to Ashland avenue, a distance of 2¼ miles. From Ashland avenue to Canal street Twelfth street is widened 42 ft., making an 108-ft. street, and is widened 52 ft. between Canal street and Michigan avenue, making an 118-ft. street.

The widening is entirely on the south side of the street.

The damages would have been practically doubled by taking off some of the private property on the north side of the street as well. The result has been, of course, the widening of the street at the expense of shortening the lots abutting along the south side.

Everybody that owned affected property and would listen to reason made money. The value of the abutting land was increased about 50 per cent by the improvement and this amounted to about three times the assessment.

A new 22-ft. concrete walk is being laid along the south side of the street. The roadway, 70 ft. wide, is being repaved with granite block. The street was formerly paved with brick. It is a heavy traffic street and has a double street car line. The paving assessment has been confirmed and the work is progressing. New street car tracks have been laid for a distance of one mile. The city brought holes made by the removal operations up to grade by filling with sand. The Chicago city railway paid for the new concrete base for its tracks and moved its rails. The great Twelfth street viaducts are within the affected area and as these are railway properties they are to be paved at the expense of the railroads and new viaducts are to be built. The cost of the property condemnation alone on this improvement was $3,500,000.

VIEWS SHOWING THE WIDENING OF TWELFTH STREET, CHICAGO.

Most of the house-moving jobs incident to the widening of this street were simple enough. One large stone church was moved and one four-story brick building of 400-ft. frontage.

From Ashland avenue to Canal street, Twelfth street will be ready for traffic by November 1 of this year. The balance of the work will probably be completed within a year. The total cost of the work will reach $6,500,000.

The engineering work has been handled by the staff of the board of local improvements, C. D. Hill, chief engineer. W. F. Cummings is contractor on the street work now nearing completion.

PAVEMENT DESIGN AND CONSTRUCTION

Present Practice in the Construction of Brick Pavements in Chicago

By H. J. Fixmer, Division Engineer in Charge Paving Construction, Board of Local Improvements, Chicago, Ill.

In all types of pavement construction it is our endeavor to build a pavement that will fulfill the requirements of the traffic using it.

Forces Acting on Pavement.

The kind of traffic using the city street and main road today is greater in volume and weight and more rapid and important than the traffic of former days. Brick construction is, as a general rule, only specified on thorofares inviting this kind of traffic. After analyzing the effects imposed on pavement construction by mixed types of vehicles, with the motor truck predominating, we are able, in time, to devise or indicate the methods to be observed in evolving a pavement that will accommodate the traffic in a satisfactory manner. The increased weight of the heavy motor truck is, statically considered, better distributed over the surface of the pavement, because of the width and resilient quality of the tire. This, in turn, is greatly counterbalanced by the impact produced by the increased speed of the vehicle. The driving wheels of the motor truck generate more friction and exert a powerful shearing force on the surface of the pavement.

In addition to the forces constantly exerted, but in varying amount, by the traffic on the surface of the pavement, there are present at times other natural forces tending to destroy the pavement structure.

These forces are, briefly, expansion and contraction, caused by climatic changes; the action of free water, in the form of frost, as a solvent, as a carrier and as an agency in compacting soils, causing settlement; and decay or deterioration caused by defects in the material, or a combination of the destructive agencies of nature.

The Foundation.

The subgrade must be properly compacted and drained. This requirement is worth all it costs, regardless of the type of pavement used, because it is virtually of permanent value.

The base or foundation of the pavement should be an unyielding structure, preferably of concrete. Where a grout filler is used good results have been secured with a macadam base, but for heavy traffic concrete is more reliable. The quality and thickness of the concrete require study and should be proportioned to satisfy the conditions of the subgrade character of

wearing surface and the amount and weight of traffic to be borne.

The "Cushion."

On the foundation there is usually placed a so-called "cushion" of sand, bituminous mastic or cement mortar.

The purpose of this layer is to form a smooth surface that will adapt itself to the uneven surface of the base and in inequalities of the bottom surface of the individual brick. Until recently it was believed that the "cushion" served to reduce the effect of impact on the surface of the individual brick. It is now well recognized that the sole function of the "cushion" is to afford an even bearing for the brick on the foundation.

Sand serves well for this purpose, provided it can be kept in rigid position. Experience has shown that vibration and the percolation of water tend to shift the sand, causing the pavement surface to settle unevenly. For this reason it is considered better practice to add cement to the sand in the proportion of 1 to 3 or 1 to 4, and wet the cushion thru the joints after the bricks are properly bedded. This enables the cushion to set up and maintain an even bearing on the concrete, regardless of the joint filler used. A serious objection to the sand cushion is its tendency to work up to the top of the brick thru the joints, particularly if the pavement is rolled too much. A sand having up to 10 per cent of loam will not roll up in the joints as much as a clean, fine sand. Where an asphalt or tar filler is used it is no disadvantage to have some of the sand come up in the joints, for it is readily penetrated by the hot bitumen and becomes a stiff mastic. Where the filler is grout the presence of sand in the joints prevents the penetration of the filler and results in the development of weak spots, which quickly become loose. The sand in the joints filters the water out, leaving a thin mortar, which dries out and does not set up properly. Where a grout filler is to be used, a mortar cushion should be provided. This cushion can be laid dry and wetted by sprinkling either immediately before laying the bricks or thru the joints after the bricks are rolled.

Because of the effect of impact of traffic a smooth surface is imperative. Many years ago brick pavements were rolled with a horse-drawn roller and the joints filled with sand. A few of these pavements are in existence to-day as monuments to the enduring quality of brick as a paving material. The joints are open and very wide, due to the rounding off of the upper edges of the individual brick. Even where the bricks were narrow there are few broken bricks.

It can be safely stated that brick is highly resistant to fracture or crushing where evenly bedded. It wears by abrasion, the amount depending on the uniform hardness or toughness of the brick and the support or protection given the joints. The quality of brick is well standardized, and its toughness, both as to degree and uniformity, readily tested.

Joint Filler.

Having secured an even surface by proper rolling and having the bricks evenly bedded on a fixed cushion, our remaining problem is to secure an adequate joint filler. The joint filler must be one that remains in place at the top surface to protect the joints and maintain an even wearing surface.

In Chicago four kinds of joint filler have been used, namely, sand, tar, asphalt and cement grout. Sand is not satisfactory. Tar has, as a rule, given poor results, particularly in recent years. It wears, breaks or flows away, leaving the upper part of the joint exposed to wear and the accumulation of filth. It is believed that the extreme range of temperature in this locality destroys its efficiency, and for this reason we are limiting ourselves to the use of asphalt and cement grout. Asphalt has given general satisfaction. It adheres well to the sides and tops of the bricks, filling any surface inequality and giving a smooth, durable surface. Pavements five years old have the asphalt flush with the joints and a thin surfacing in spots. Where the grades of the street vary greatly or are excessive, an asphalt filler should be preferred. The use of the grout filler has been revived this year, and where a grout cushion is used excellent results are expected.

The grout is mixed in the standard proportion of equal parts of cement and sand. On some jobs the standard hand-mixing box was used. On one job the material was mixed in a small batch mixer and conveyed to the grouting area in carts having revolving paddles fixed to the axle of the wheels. In this way the mixture was kept agitated, and when dumped was of even color and uniform consistency. The grout was applied in two courses, and rarely required three applications. A stiff broom was used with the thin, or first, application, and a rubber squeegee with the final application. A smooth surface was secured, the joints filled flush and any slight defects in the brick evenly filled. The streets were barricaded seven or more days and kept sprinkled for the first three days. Where a repressed brick or a mortar cushion was used, one barrel of cement filled 29 sq. yds. of pavement. Where a lug (wire-cut) brick was used on a sand cushion, one barrel of cement was used to form 24 to 28 sq. yds. of pavement. This variation is due to the amount of sand coming up in the joints. On the cement-sand cushion, mixed 1 part cement to 4 parts sand, one barrel of cement laid 18 sq. yds. 1 in. thick.

Where a sand cushion was used some trouble was experienced in getting the proper amount of grout in the joints, due to the cushion working up, necessitating taking up and relaying the brick.

Details of Construction.

On the brick pavements laid under my direction this year the middle 16 ft. is occupied and constructed by the street railway company. This middle strip is paved with granite blocks with a grout filler. On these streets four rows of granite blocks are laid outside the rail on a mortar cushion. On one street the granite strips were filled with tar and torpedo sand, the other streets having the granite filled with grout similar to the adjacent brick pavement. An expansion joint, filled with bitumen, is provided along the face of the curb and continued across intersecting streets and alleys. No transverse expansion joints are built.

The purpose of using the four rows of granite blocks outside the rail was to take care of the excessive wear due to the habit of vehicles driving along the rails and turning out abruptly. The four rows extend beyond the ends of the ties, and, where the joints are filled with bitumen, little, if any, vibration is communicated to the adjacent monolithic brick slab.

In order to minimize the effect of expansion, the crown was made as slight as practicable, and no abrupt changes, such as raised cross-walks, built at intersecting streets, as was formerly the practice. The pavement is built flush with the curb for a width of 6 ft., corresponding with the sidewalk, across the alley and street intersections, along the line of the maximum pedestrian traffic. At the curb corners the pavement is 4 to 6 in. below the rail (curb grade), running thence to the inlet located about 50 ft. from the curb corner. The crown at the inlet varies from 8 to 10 in. below the rail or curb, depending on the width of the roadway. This construction creates a step of from 5 to 7 in. at the cross-walk crossing the street. This tends to cause a pedestrian to pause before crossing the busy street and eliminates the familiar "bump" in the line of greatest vehicle traffic. A grout-filled brick pavement laid on a 1-in. mortar cushion, on a 6-in. cement base, is rigid and semi-monolithic. It is believed that this type will prove satisfactory for the traffic and will resist climatic changes. The cushion should set up with the grout in the joints, permitting the concrete to slide under the cushion and thus not communicate cracks from the base up thru the pavement. Since the pavement is smooth, its rigidity, or lack of (alleged)

"elasticity," gives a more durable and comfortable surface for all types of wheel traffic. All vehicles are now equipped with springs and a majority travel on rubber tires.

The horse is destined to disappear from the city street. If used, he should be shod with rubber or other smooth shoes.

Conclusions.

Some objection has been raised that the grout-filled pavement is difficult to tear up, and even more difficult to repair. This is true. However, we are not building pavements for the purpose of tearing them up readily. This is a questionable, or at most an incidental, defect. This type of pavement can be properly repaired, but it requires skill and care. It is the writer's opinion that an asphalt or grout-filled brick pavement on a 1-in. mortar cushion, on a good 6-in. concrete base, is an excellent type for the normal business or car-line street. It will require very little repairs or maintenance. Where the filler wears down, the pavement can be restored by a light application of hot asphalt, with a sand dressing. If this is done regularly, say every three to five years, the pavement should last from twenty-five to forty years and be in a smooth condition all that time. The new ideal pavement must have the qualities of smoothness, rigidity, durability, strength, good traction, be comfortable to ride upon, and be easily cleaned. A properly constructed brick pavement realizes all these advantages to a noticeable extent.

The Construction of Concrete Curbs for Asphalt Roads

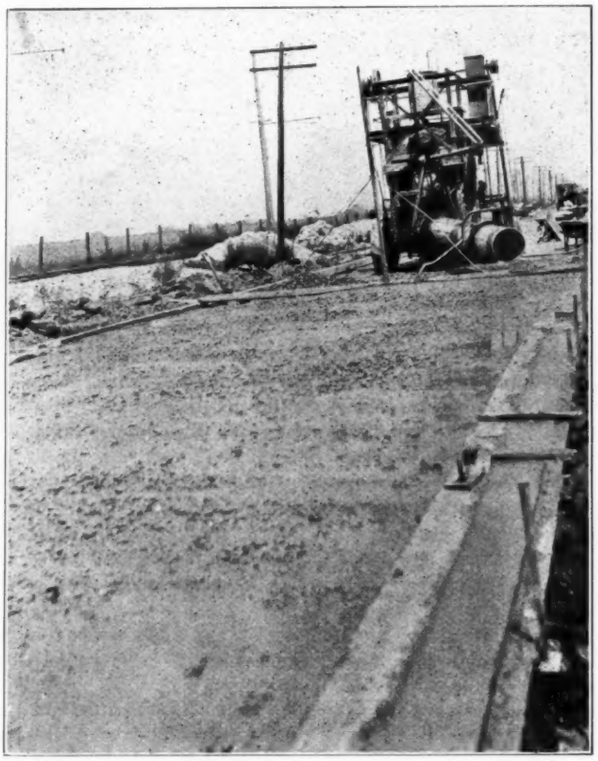
Concrete headers or curbs for bituminous roads are being provided for in a great deal of road building where formerly it was not considered necessary, whether or not a concrete base was used. Probably no type of road is increasing in popularity more rapidly than the concrete-base asphalt top, or so-called combination road. This fact makes it all the more desirable to emphasize the necessity of side support for such roads, and this can only be effectively provided for by concrete curbs.

The good reputation of asphalt wearing surfaces is based largely upon the performance of such surfaces on city streets, where curbs are almost invariably provided. In proportion to the traffic carried, such side support is just as necessary on roads as for pavements. A very good example of the truth of this statement was noted recently during the inspection of a Long Island Topeka specification road, now five years old, and in good condition except along the edges, where the asphalt top was almost continuously broken down along the shoulder of the road. The maintenance of something more than a mile of this road for the five-year period would have amounted to practically nothing but for the repairs necessary at the edges of the road, all of which would have been avoided if a concrete curb or header had been provided in the first instance.

The concrete header is not only desirable, but it is obviously equally desirable that when it is provided for it should be built rightly. In too many cases the base is first laid and allowed to set. Then concrete for a curb perhaps 4 in. wide and the depth of the asphalt wearing surface is placed between boards and troweled finished. This is decidedly the wrong way to go about the making of a curb capable of protecting the edges of a road upon which teams are constantly turning out. As a matter of fact, such curbing can usually be kicked out of place, and it is eventually broken off even where much of it is left intact by the roller compressing the asphalt top.

The only way in which substantial curb construction can be secured is by casting the curb integrally with the base. It costs no more to do the work this way and it is useless to do it any other way. Either wood or metal forms may be used, but the latter are preferable, because they can be easily drawn and spiked down ahead as the work proceeds. After the base proper is laid, but before it has finally set, a wood or metal strip of the desired height of the curb is placed to form the inner edge of the curb, and the concrete therefor is then laid between the outer and inner form pieces. In the half-tone herewith metal forms are being used for the outer side of the curb and base and wooden strips for the inner side of the curb, the latter being tied to the metal plates to prevent displacement of the wooden strips when the curb concrete is placed and tamped.

The simple method here described can, of course, only be followed where concrete base is provided. In the case of resurfacing macadam with new asphalt tops it is very desirable



VIEW SHOWING CASTING CONCRETE CURB INTEGRAL WITH BASE, MONROE-TOLEDO ROAD CONSTRUCTION.

to install concrete curbing even if it is only 10 or 12 in. deep. This not only prevents injury to the edges of the road, but greatly improves its appearance, as compared to the ragged edges so often seen on careless bituminous construction.

The conviction, based upon ample demonstration, that roads are not wearing out nearly so fast as they are breaking down under weight of traffic is largely responsible for the opinion that dependable foundations, preferably concrete, with mixed method asphalt tops, to provide good and cheap wearing surfaces and protect the concrete from cracking and heaving, meet the requirements of present-day traffic weights and at the same time come within reasonable limits of cost.

Relative Bleeding of Rectangular Wood and Kreolite Lug Paving Blocks

Tests were recently made by Clyde T. Morris, professor of civil engineering, Ohio State University, Columbus, to determine the relative bleeding of rectangular blocks and Kreolite lug wood paving blocks when submitted to the same pressure under equal conditions.

Data observed in the tests show that if the blocks expand 0.2 in. each, the rectangular blocks exert a lateral pressure of 415 lbs. per sq. in., while the lug blocks exert a pressure of

only 125 lbs. per sq. in. Likewise, for the same amount of expansion, the rectangular blocks bleed three and one-half times as much as the lug blocks.

Six samples of wood block were tested in a Riehle hydraulic machine. The loads were applied in increments of 25 lbs. per sq. in. of block at intervals of one minute. All blocks were tested on the side. Observations were made of the total deformation of the block at each load increment and also the amount of bleeding caused by the pressure.

The oil and water squeezed out was absorbed by blotters and these were weighed before and after the test to determine the amount of oil lost by the block at the various pressures. The areas of the bleeding were determined from the imprint left on the blotters.

Prevention of Bleeding

An authority on wood block paving states that by using open joint construction with blocks laid upon a mortar cushion, bleeding may be almost entirely prevented. About ½-in. of sand should first be swept into the interstices between the blocks to serve as a dam to prevent the possible floating of the blocks. A squeegee coating of pitch should then be applied to the surface of the blocks to fill the spaces to within about 1 or 1½ ins. from the surface of the pavement; the remaining portions of joints should then be filled with sharp pea gravel, or slag sand, and at the same time a top dressing of the same material to a depth of ½ in. left over the surface for traffic to work into the upper fibers of the wood and thoroughly into spaces between blocks.

This style of construction has been called open joint "Pitch-Wich" construction—a little sand, pitch and then more sand, making the resultant surface entirely waterproof. As blocks expand pitch will not be oozed from spaces between blocks; as the wood swells, sand will be forced from spaces instead of pitch.

This method of construction has been used successfully on such prominent thoroughfares as Sixth street, Cincinnati; Vine street, Cincinnati, and Euclid avenue, Cleveland, Ohio, with no bleeding as the result.

The Recent Revision of Ideas About Brick Pavement Construction

Methods of building brick roads have undergone radical changes during the past two years. Types of construction have changed and fundamental ideas have been revised. Two distinct advantages have resulted: Better roads are being built and with less material than the old types required.

Passing of the Cushion.

Formerly a sand cushion between the artificial foundation and the brick surfacing was considered necessary in order to afford an even bearing surface for the brick and to give the resilience theoretically assumed to be required for absorbing and distributing the shock of traffic. Formerly, also, the artificial foundation was regarded as the chief factor in the load-bearing strength of the pavement. Experience and experimental tests have demonstrated the fallacy of both theories.

The rigid type of construction, in which the brick surfacing and the artificial foundation are united in a single beam, has doomed the sand cushion to the discard. It is now known that the brick surfacing, if properly bonded with cement-grout filler, is the real load-bearing part of the pavement, and that the chief function of the artificial foundation is to afford a stable, even bearing for the brick.

The State Highway Department of Illinois has laid a considerable mileage of brick on a 1-in. concrete foundation. Many engineers are constructing brick roads with concrete foundations 2 in. and 3 in. deep, instead of 6 in., as formerly. In other instances 1 in. of cement-sand mortar is used as a bed over old macadam or on gravel soil or road.

Moonolithic Brick Pavements.

Of course, in every case in which a shallow concrete foundation is used, the monolithic type of construction is employed. The brick are laid in the wet concrete and are bonded with cement grout filler.

Experiments conducted during the year 1916 to determine the relative resistance to load stresses of brick surfacing and concrete foundations disclosed that with monolithic construction the brick actually lend strength to the foundation, and so also was revealed the fact that the brick hold the concrete foundation so firmly that the expansion and contraction of the latter coincided with the expansion and contraction of the brick, altho when experimented with separately concrete and brick showed marked variations in expansive ranges under heat and moisture influences.

Doubtless the fact that concrete foundations are protected from heat and moisture by the brick surfacing accounts in great measure for the equalizing of the respective coefficients of expansion under the practical conditions established by pavement construction; but the assertion, based upon a series of experiments conducted under the most careful safeguards, that in the brick surfacing resides the main load-resisting strength of a pavement, confirms the contention of proponents of rigid brick pavements that such pavements are the strongest general purpose pavements that can be constructed.

The virtual invulnerability of vitrified brick to abrasion and moisture was already established by the history of hundreds of brick pavements, but until recently the need of a deep foundation was generally conceded.

Now that laboratory tests and practical service tests have proven that a 4-in. green concrete foundation, with a 4-in. vitrified brick surfacing, give a much stronger pavement than was formerly obtained by the use of a 6-in. concrete foundation, a 1½-in. sand cushion and a 4-in. brick top, the cost of brick pavements, allowing for no change in cost of labor and materials, is materially reduced.

The reduction in cost is made greater by the fact that monolithic construction of highways eliminates flush side edgings and curbs, while the rapidity with which monolithic pavements can be constructed effects an additional saving in the item of labor costs.

In many instances a 3-in. brick of the wire-cut lug type, instead of a standard 4-in. wire-cut lug brick, is used on a 4-in. green concrete foundation, or upon a 4-in. set-up foundation with a 1-in. cement-sand bed for a superfoundation, which binds the brick to the foundation and makes the pavement a single rigid beam from surface to sub-base or natural soil. These brick are used because of their superior bonding strength and square edges.

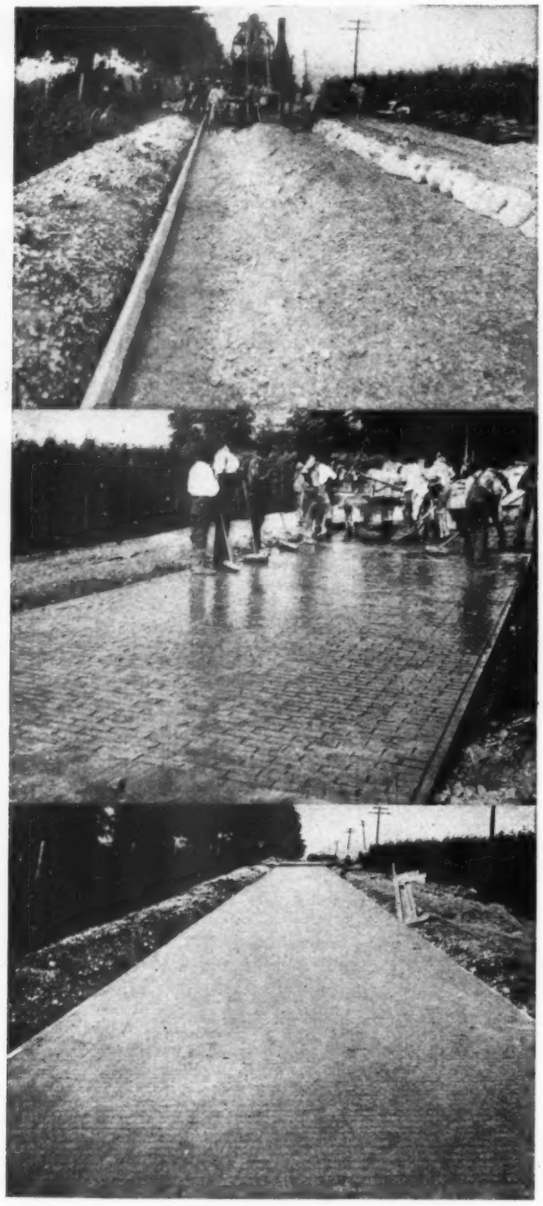
Advantages of Monolithic Pavements.

The monolithic and semi-monolithic types of pavement—as the green concrete foundation and the cement-sand bed types are called, respectively—are solid, practically noiseless, smooth, sanitary and durable. They originate no dust or dirt, are easily cleaned, and are not in any way affected by motor-vehicle, iron-tired vehicle traffic, or by surface moisture. A well-constructed brick pavement of either type neither becomes wavy nor slippery, nor pits, ruts, ravels nor disintegrates. It remains smooth and even on the surface and is good for all kinds of traffic.

Monolithic brick pavements are now used almost exclusively for brick highways in several states, including the states of Indiana and Illinois. The principle of the rigid beam from surface to sub-base has been found scientifically sound and advantageous from the construction standpoint.

An additional advantage is that inasmuch as all phases of the work are going on at the same time within a distance of 50 ft., the engineer in charge can have all the work under his eye at all times. The contractor also can bring his organiza-

tion to a high state of efficiency by concentrating and systematizing his work and by saving the time ordinarily required in going from one part of the work to another. In fact, the contractor, having all the work under his immediate supervision virtually at a single point, can very easily dispense with a foreman, provided that the contractor is able to devote all his time to the job in hand.



VIEWS SHOWING CONSTRUCTION OF WIRE-CUT LUG MONOLITHIC BRICK HIGHWAY, EDGAR COUNTY, ILL.

In the South, notably in Florida, where the sand drains easily and can be compacted solidly by puddling, more than 100 miles of highways have been constructed with grouted wire-cut lug brick laid on a natural soil foundation. In these cases the monolithic brick slab has proven entirely adequate to sustain regular auto-truck traffic.

This object lesson gives additional confirmation to the opinion that, given a stable, even-bearing foundation, either artificial or natural soil, a well-bonded and smooth brick surfacing is the prime factor in the load-bearing capacity of a brick pavement.

Construction Features of Monolithic Pavements.

The constructional features of a monolithic pavement are a wet concrete foundation reduced to a true cross-section, upon which the brick are laid and immediately rolled, culled and grouted. The object is to obtain a single rigid beam, all parts of which are strongly united. In order to attain that end it is necessary to grout the pavement immediately after laying and rolling the brick, so that the grout filler, going to the bottom of the joints, shall form a homogeneous union with the green concrete foundation.

An essential feature, but one not always regarded in practice, is sprinkling the grouted pavement and keeping it covered with earth or straw for two or three days, so that the grout filler will not set too quickly and crumble.

Of course, as the concrete foundation is green, it is not feasible to use a heavy self-propelling roller for rolling the brick. A twin-cylinder hand roller, about 30 in. long, and weighing, when filled with water, about 800 lbs., gives the best results.

The green concrete foundation is brought to a true contour with either smoothing template or a tamping template designed especially for the purpose. Care must be taken in getting the surface of the foundation to the true contour of the surface of the completed pavement and at the right uniform depth below the surface contour. Care must also be exercised in assuring complete penetration of the grout to all parts of the joint and to the bottom of the brick, as strong bonding together of the brick and of the brick to the foundation are absolutely essential to good construction.

The foundation should be of proper consistency to bear up the brick when they are rolled, yet the moisture content should be sufficient to allow of easy shaping of the surface and to assure a perfect union with the brick surfacing. A foundation too dry is difficult to shape smoothly and it is liable to contain voids and lack uniform density.

No arbitrary rules can be laid down for mixing the concrete for the foundation. Each engineer must exercise discretion in the use of water, so that the concrete shall be of the proper consistency. A little experience or close observation will enable the engineer to fix the amount of water to use; but one detail cannot be neglected: The concrete must not be carried in a barrow for dumping; it must be put in place with the least possible chance for separation of the components.

Owing to conditions produced by the war it is not practicable to give reliable cost data for monolithic brick pavements. The length of hauls, the prices of materials and the price and available supply of labor are so unstable and they vary so much at different points, that estimates made for one point or for one period of time may not be serviceable at other points or at other times.

Quantitative Data.

Quantitative estimates are all that can be made with confidence at this time.

Wire-cut lug brick lay 40 to the sq. yd., or 25 sq. yds. to the thousand. Assuming that a 4-in. concrete foundation mixed 1:3:6 is designed, approximately 0.123 of a barrel of cement would be required per sq. yd. For grouting, 1 to 1 mixture, the requirement per sq. yd. is 0.037 of a barrel of cement. For a sand-cement bed, 1 in. thick, 1 to 4 mixture, designed for semi-monolithic pavement, 0.051 of a barrel of cement is used per sq. yd. The cost of sand or gravel depends upon the proximity of the supply and local market quotations.

There is a tendency on the part of some engineers to use a stronger mixture for both foundation and cement-sand beds, 1:2½:5 for the former and 1:3 for the latter. In that case it would require 0.144 of a barrel of cement per sq. yd. for the base and 0.065 of a barrel of cement per sq. yd. of area for cement-sand bed 1 in. deep.

SEWER DESIGN AND CONSTRUCTION

Features of Sewer Construction Work at Elmhurst, Ill., and South Bend, Ind., Using Lock Joint Sewer Tile

Two interesting sewer construction jobs in which Lock Joint Sewer Tile are employed are under way at Elmhurst, Ill., and South Bend, Ind., respectively. At Elmhurst there are 2,690 ft. of 42-in. sewer in an average cut of 17 ft., and 4,660 ft. of 36-in. sewer in an average cut of 14 ft. There are also about six miles of clay pipe sewer ranging from 24 in. in diameter down to 6 in.

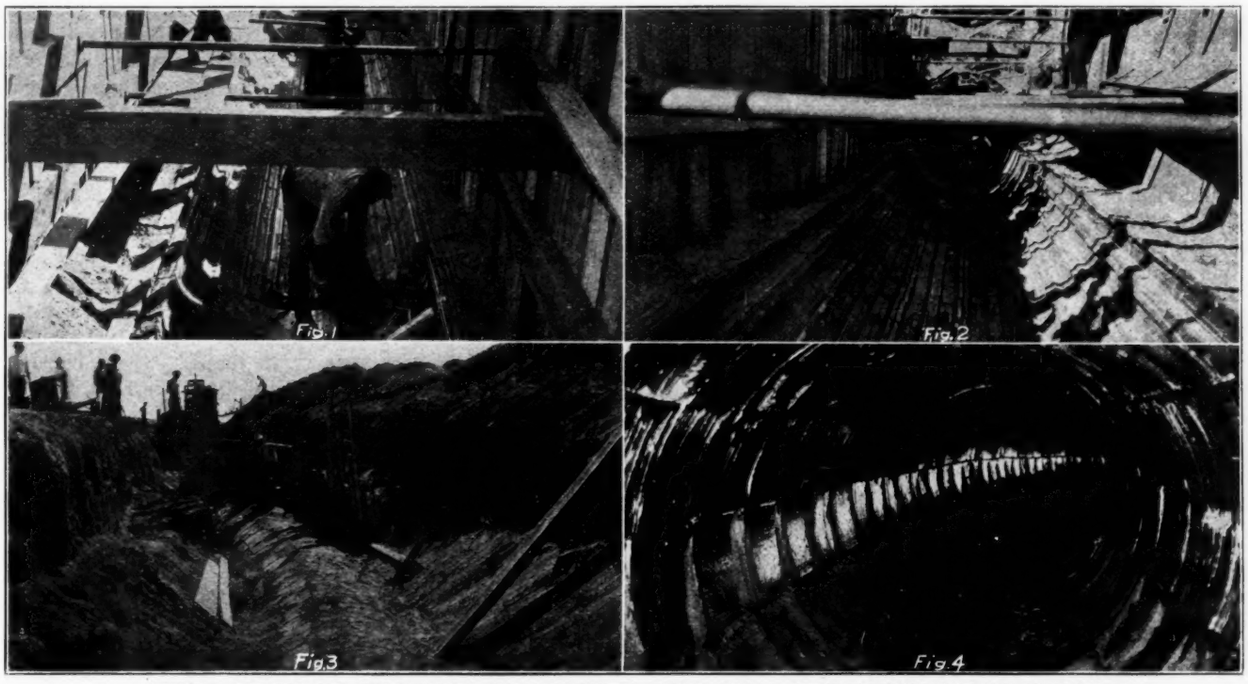
The Elmhurst Job

A Parson's excavating machine is employed to cut the trench for the block sewer. It will cut 72 ins. wide, but is set to cut a 66-in. trench on the 42-in. sewer and a 60-in. trench on the 36-in. sewer. An Austin "O" excavator is used in trenching for the tile pipe sewers. Brick manholes are located in the line about 260 ft. apart. The tile pipe sewer trenches are back filled with an Austin gasoline backfiller and the block sewer trenches are back filled with a Parson's gasoline power backfiller.

The work on the Elmhurst job started March 5 and will end early in October. At the time of beginning the work there was 3 ft. of frost in the ground and it was found that the machine would cut through only 18 ins. of frost, so the contractor waited for a thaw before proceeding with the work.

The soil consists mostly of clay. A stretch of quicksand 1,000 ft. long in a 25-ft. cut was encountered on the 42-in. line. In the quicksand the excavation was kept down to a depth of 18 ft. with the machine and the trench was sheeted solid to a depth of 20 ft. below the surface. The remaining 2 ft. of clay and 3 ft. of quicksand were taken out by hand in buckets of ½ barrel capacity pulled up by windlasses.

A great deal of trouble was experienced with the sheeting on account of the weight of the excavating machine, the deep cut and the underlying quicksand. Wood stringers and iron extension sewer braces were used exclusively in bracing the trench. The iron braces were set at the corners of 5-ft. squares. The sheeting was of 2-in. planking, 20 ft. long, and was put in by hand. To unwater the trench a pulsometer pump was employed, using steam taken off of the boiler on the Parson's excavator. Two gasoline trench pumps were also employed on this work.



VIEWS OF SEWER CONSTRUCTION AT SOUTH BEND, IND., USING LOCK JOINT SEWER TILE.

Fig. 1.—Laying the invert; two courses of block with ¼-in. bed of 1:2 mortar between. Fig. 2—Crown and form for springing the arch. Fig. 3—Typical view of curve. Fig. 4—Interior view of curve before joints were pointed or sewer cleaned out.

The average rate of progress on the 42-in. sewer was 30 ft. of completed sewer a day. The organization of the contractor's forces at Elmhurst was as follows:

Two men laying block (1 invert, 1 crown), 1 man tending masons, 2 men lowering blocks, 2 men carrying blocks and mortar, 1 man mixing mortar (1 to 1 mix).

The men laying the sewer blocks were paid 40c an hour and common labor on the job was paid 30c an hour. The force worked 10 hours a day.

One engineer and one fireman were regularly employed on the machine. Altogether there were 17 men in the construction crew. In addition to those enumerated there was a crew on the sheeting work and one trimming the bottom of the trench to the size and shape of the outside diameter of the sewer. The contractor and one foreman were in charge of the

work. The contractor on this job was Henry Reese of Quincy, Ill. Warton Platner of Chicago, was consulting engineer.

The best day's work on the 42-in. sewer was 86 ft. In the quicksand section the progress was about 14 or 15 ft. a day. This work was done in rainy weather.

The line of the sewer contains three curves, one of a 20-ft. radius and the other two of 50-ft. radii. In going around the sharp curve half blocks were used on the inside of the sewer and thin joints were used and a neat job realized.

In laying the lower half of the sewer a steel template was placed for every course of blocks. Wood center forms running inside of the completed lower half formed the frame for turning the crown on the sewer. The steel template consisted of a steel angle iron bent to the diameter of the outside of the sewer and braced across the top so that it could not spread. This held the blocks in place until back-filling around them had been completed. This back-filling was done as soon as possible as the work progressed. After one course was thus back-filled the template was shifted to the next course.

About 300 ft. of rock was encountered in the 42-in. sewer which was blasted out with dynamite. Air was piped from a stone quarry compressing plant about two blocks away and used to operate the air drills. A good deal of rock was encountered on the pipe sewers.

On the 36-in. sewer the progress ranged from 40 to 120 ft. per day in good ground. The average on this sewer was 80 ft. per day.

The specifications drawn up to govern the bidding on this job included all makes of vitrified block. The contract was awarded to the National Fire Proofing Company of Pittsburgh. Under the Illinois law governing local improvements, only one material can be specified on special assessment work. O. H. Stange is chairman of public works in Elmhurst and was inspector on this job.

The South Bend Job

The work at South Bend consists of 2,380 ft. of 5-ft. sewer in an average cut of 14 ft.; 1,250 feet of 54-in. sewer in an average cut of 12 ft., and a small amount of 36-in. sewer at a road crossing.

The specifications under which bids for material were received included all makes of blocks and reinforced concrete pipe. The bid on the blocks was $13.48 per ft. of completed sewer and that on the concrete pipe was $13.45 on the 5-ft. sewer. On the 54-in. sewer the bid on the concrete pipe was $12.30 per ft. of completed sewer and on the vitrified block $12.35. The vitrified block proposal was accepted and the block was furnished again by the National Fire Proofing Company of Pittsburgh.

At South Bend the soil encountered was sand and gravel on the 60-in. line and sand and clay on the 54-in. At the outfall of the sewer 200 ft. of the line passed through low land adjacent to the river. Here water in the trench was encountered and one gasoline pump was used to unwater this trench. The cut here was only 2 ft. deep and the sewer was later covered with 8 ft. of sand covering. The contractor on this job is the National Company of South Bend, with George Harrop in charge. F. Anderson is city engineer.

The trench was excavated by an Austin gasoline excavating machine cutting a trench 42 ins. wide. Workmen spudded in the bank by hand to a width of 75 ins. Four men were employed on this work all the time. The bank was broken in and the earth thrown within reach of the exeavator. On this job there were employed 1 foreman, 1 superintendent, 1 engineer on the machine, 2 block layers, 2 helpers, 2 men lowering and carrying blocks, 1 mixing mortar, 1 wheeling mortar, 4 men sheeting and 4 men shaping the trench bottom to the proper diameter and shoveling into buckets and throwing dirt into the excavator. The block layers in this case were brick layers and were paid 65c per hour. The other labor was paid 35c per hour and a ten-hour day was in force.

A cable way was used in cutting down a bluff where the cut reached a total depth of 32 feet. At this point the sewer had a rise of 1 ft. in 10 for a distance of 100 ft. This bluff was at the edge of the bottom land previously mentioned, adjacent to the St. Joe river.

The best day's work on the 60-in. sewer was 75 feet of completed sewer. At the time of writing, no 54-in. sewer has been laid. The work at South Bend started on July 10 and will probably be finished by November 1.

The South Bend sewer line contains a good many compound curves. The sharpest curve is of a 50-ft. radius. Full sized blocks were used in going around these curves but the joints were made thin on the inside so as to produce a smooth job.

On the South Bend work a wood template was set 30 ft. ahead and guide lines stretched for the invert. The crown was set on a 15-ft. wood form, mounted on wheels to run ahead on the lower completed half of the sewer, upon which to turn the arch. The trench was shaped to the true diameter of the sewer by hand. Some sheeting in deep cut was done by hand. A gasoline back-filler was used on all South Bend trenches.

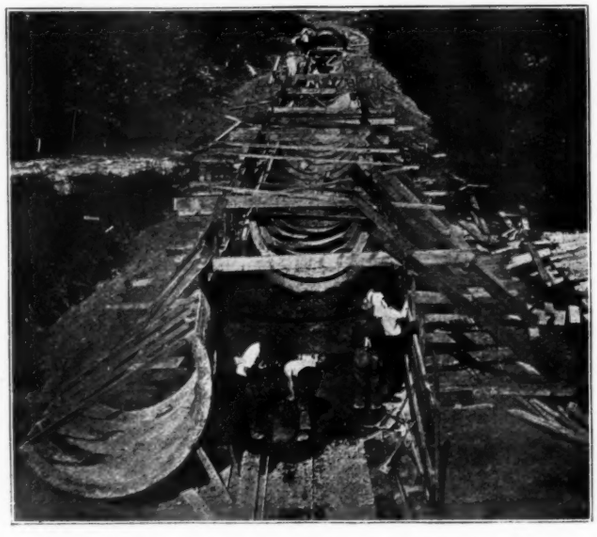
The South Bend sewer is a combined trunk sewer and has a 6-in. connection every 60 ft. Brick manholes are 300 ft. apart on the line. Mr. R. B. Peters of the Chicago office of the National Fire Proofing Company sold both of these jobs and looked after construction. We are indebted to him for the photographs shown herewith.

Construction Plant and Methods Employed in Building the Woodville Avenue Sewer, Toronto, Ont.

The Woodville avenue sewer, in the city of Toronto, Ont., is 5,780 ft. long and is 8 ft. in diameter. The first 240 ft. of the sewer was built on bents, the next 1,650 ft. were built in open cut and the last 3,890 ft. in tunnel. The construction methods employed on these three sections are here described.

The Section on Bents

The shallow ravine which necessitated these 240 ft. of bents is the bed of a creek which in former times was much



CONSTRUCTION VIEW ON OPEN CUT SECTION, WOODVILLE AVE. SEWER, TORONTO.

larger but is now contained in a 3-ft. concrete pipe which terminated at Conduit street at the time when the construction of the Woodville avenue sewer was begun. At that time the

pipe was extended and the ravine was afterwards filled in where Woodville avenue crosses it, with surplus material taken from the sewer excavation. This filling provided both the roadway and a future foundation for the sewer when the bents will have decayed. As in the case of Clendenan avenue, pipes were left through the bottom of the sewer through which sand was later run to fill the space left by shrinkage.

An excavation 3 ft. deep was made across this ravine to obtain a solid foundation for the timber bents. In the center and low part of the ravine, the ground for 30 ft. was rather soft and on this account a 3-in. plank decking, placed lengthwise of the sewer with broken butt joints was provided for the sills to rest upon. Throughout the remainder of this excavation the sills rested on the ground. The bents were 5 ft. apart between centers. The sills are 10x12-in., five vertical 10x10-in. posts, 2-ft. 6-in. centers rest on each of these sills and are let into them 1 inch, and are held apart by light 2x8-in. straps. There is an 8x6-in. runner placed lengthwise with the sewer at the top of each row of posts and let into the sides of the posts 3 inches. A 3-in. decking is then placed over all, leaving the tops of the posts exposed.

The sewer in this section is culvert-shaped outside with a semi-circular top, while the inside is circular. The crown and invert of the sewer are built of reinforced concrete with a half ring of paving brick in the invert for a wearing surface. The concrete in the bottom is 1:2:4 mix and is provided with a layer of 0.3 sq. in. per square foot mesh 2 in. from the bottom. At the springing line of the arch the concrete is 18 ins. thick and gradually reduces to 12 ins. thick in the crown. Two layers of mesh of the same weight as used in the invert are used in the crown, one near the outside and the other near the inside. The outside layer extends around the top and down the side walls to the flow line, while the inner layer extends only to the springing line of the arch.

The Section in Open Cut

The part of this section as far as Humberside avenue was at an average depth of 22 ft. and was built of three rings of brick. At this point, a 4-ft. ramp was provided, but in spite of this, the average depth from Humberside avenue to Annette street was 29 ft. and this part was built of four rings of brick. At Annette street, another 4-ft. ramp was provided. From Conduit street Humberside avenue the grade is 1 ft. in 185 ft. Two lateral sewers, a 12-in. and a 15-in., are picked up. From Humberside avenue to Annette street the grade is 1 ft. in 195 ft. At Annette street a chamber was designed to pick up five laterals, a 12-in. and a 24-in. pipe, a 2-ft. x 3-ft. and a 2-ft. x 4-ft. (all brick.)

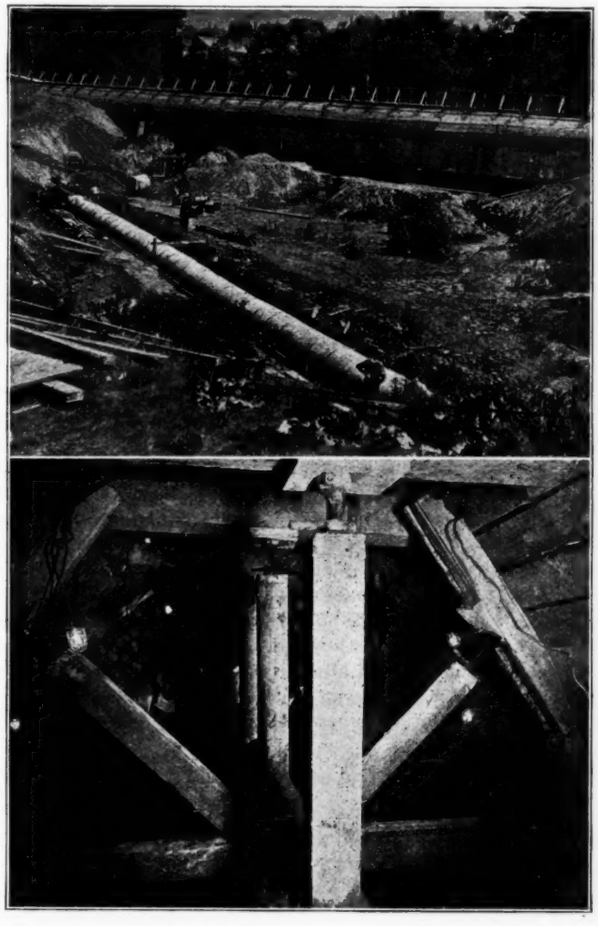
Cableway

As an aid to handling the material from this excavation a cableway 250-ft. in length was provided. The excavated material was raised from the bottom of the trench in ½ cu. yd. buckets by the cableway and carried to the rear, part to be used as back-fill over the completed sewer, and the rest to be hauled in wagons to the nearby ravine. At first, the bottom of the excavated trench was dry and the work proceeded rapidly, but as the trench was continued northerly and became deeper, the bottom became soft and wet. It was necessary then to square the bottom and use decking. This extra labor of course delayed the work, but it was, nevertheless, well managed and quickly accomplished. The bricks were hauled to the job in wagons and piled along the trench, whence they were lowered as required in iron backets, each holding about twenty bricks.

North of Humberside avenue, the contractor intended to construct the sewer in tunnel, but the ground was found to be too wet for tunneling without the aid of compressed air. It was found, after investigation, that this could not be economicaly used for two reasons. One was the presence of a badly cracked old storm sewer about 5 ft. above the crown, and the other was the fact that about 10 ft. or 12 ft. of the ground on the surface was filled, and therefore of a loose nature. The open cut was accordingly continued to Annette street.

Tunnel Section

A total of 3,890 ft. of this sewer were planned to be built in tunnel. It was now certain that the ground would be very wet. This had been suspected from borings taken, but it was thought that these might indicate merely a local condition.



UPPER—VIEW OF 8-FT. AND 3-FT. CONCRETE SEWERS, TORONTO. LOWER—NEEDLE BEAM METHOD OF SUPPORTING SHEETING IN TUNNEL SECTION.

Accordingly, it was decided that compressed air would be necessary to drive out the water and a pair of compressed air pumps of 1,000 cu. ft. capacity were provided and a plant erected. It was later found that these two pumps did not supply sufficient pressure and a third and later a fourth were added to the plant. South of the C. P. R. tracks, an open cut 70 ft. long was made for locks and shaft. When the locks were built, a hollow wedge of timbers was forced over them into the solid earth at each end of the open cut. This wedge was filled with concrete and served to seal up the broken strata at and over the ends of the lot, and so help to prevent the escape of air. A shaft was timbered up midway between the two lots, and the remainder of the open cut back-filled. A head-frame was then built over the top of the shaft and a rough skip, with guides on two sides, was used for raising and lowering surplus and building material. The proximity of a C. P. R. siding was a convenience in handling material. Bricks, cement, timber, etc., were unloaded into the sheds there and carried to the shaft in small cars as required. Tunnelling was proceeded with in both directions simultaneously, but work had to be suspended in the north tunnel because it was

found that all the air available at the time was needed in the south tunnel.

South Tunnel

Work in this direction went well for a time but was delayed on several occasions by the escape of the air into an old local sewer overhead. The joints in this sewer were very imperfectly made and in a number of cases the pipes were cracked. The escaping air carried the supporting earth into the old sewer in such quantities that it collapsed and had to be rebuilt before work could be carried on underneath. At Dundas street the worst of these breaks occurred under the street railway tracks and for a few days the street cars had to turn back at this point instead of at Keele street. Repairs were made by open cutting and supporting the tracks with heavy timbers. When this point was successfully passed, the work went smoothly for a time. However, the overhead cover of earth was now becoming less and it was increasingly difficult to contain enough pressure in the tunnel. When, added to this, defects in another old overhead sewer were encountered, tunnelling had to be abanded and the old sewer had to be moved to one side and rebuilt. A test hole was made to prove the exact location of the eend of the tunnel. The cableway was again set up and an open cut 360 ft. long was proceeded with. Here it was necessary to use heavier timber than was used in the other open cut since the sewer made a slight bend at this point, which brought it close to the houses on the street. Since the bottom of the trench here was very wet and the ground running sand, besides putting heavier timber in the work the contractors cut holes in the brick work foundations of the buildings and inserted under them heavy timbers which were held in place with jacks. Every day levels were taken and if the timbers showed any sign of settlement, the jacks were tightened. This work was given such good and close attention that when the open cut was complete and the back-fill made the buildings showed not the least sign of settlement. The holes were then filled up and everything left as formerly. The sewer was now complete as far north as the shaft at the tracks.

North Tunnel

When work was resumed on north tunnel all the air from the two pumps was turned into it. But very soon this was found to be insufficient, and it was at this point that the third and then the fourth pumps were added to the plant. The addition of a fifth was considered, but it was decided that the four pumps were supplying as great a pressure as the ground conditions would permit. Progress was very slow, averaging only 2 or 3 ft. per day.

Difficulties Encountered

The worst difficulties were encountered under the C. P. R. tracks, where the natural strata of the earth had been broken up by the constant pounding and vibration caused by the heavy engines and trains. Work had to be suspended and the air turned off, sometimes every other day, to allow the ground to settle and consolidate. Every scheme that could be thought of was used to assist in this consolidation. The surface was soaked constantly with water, sand was brought and washed into the ground, sand bags were heaped up between the tracks to hold the ground down when the pressure was on in the tunnel, and grout was pumped into the earth from the surface and through the brick work of the sewer. At this time blow-holes could be seen all over the surface of the ground above the tunnel. These were sometimes so large that the end of a pick handle could be shoved into them and the sand blown therefrom would rise six or seven inches from the mouth of the hole. At some distances from the center line of the tunnel the surface of the ground looked as though it was covered with small ant-hills and the sand was constantly in motion. The greatest pressure that could be used was twenty-six pounds, which was often barely sufficient to dry the ground. The bottom foot or two of the excavation was frequently wet and sometimes took as long to prepare and remove as the 10 or 11 ft. above.

When the heading got so far away from the shaft that it was no longer economical to use man power on the construction cars, mules were introduced to do this work. Two cars were hitched together and one mule would draw them. The mules, however, did not like the compressed air any too well and when first introduced to it raised considerable objection.

After the Canadian Pacific Railway tracks were passed the work continued fairly regularly until Mulock avenue was reached, where an old local sewer again gave trouble. This was a tile-pipe sewer with joints so imperfectly made that the air escaped into it in ever-increasing quantity until it was found impossible to contain enough pressure to hold back the water. It was then decided that the old sewer would have to be plugged and a new local was built along each boulevard. Every effort had been made to avoid doing this; the contractors even hauled earth from the south side of the tracks (about one-quarter mile) and deposited it on the street to a depth of two or three feet, also a new lock was built near the heading which would reduce the volume of air and, therefore, the area for possible escape. The compressors were also moved up and pipes driven from the surface through which the air was pumped into the tunnel. But all these efforts proved of no avail and the new locals had to be built.

Advantage was taken of this delay to test the line of the sewer. This was considered advisable since the line had been carried around three curves from the shaft south of the tracks where it was first taken down. Two 6-in. pipes covered by caps were driven from the surface of the ground on the correct line ahead of the work. When these were driven to a sufficient depth plumb lines were dropped to the bottom, the top ends of which were placed exactly on the correct line of the sewer. Afterwards, when the tunnel reached these points, the resident engineer found to his satisfaction that his line was almost exactly true.

While the new locals were being built, a new shaft was sunk at a point on Mulock avenue, north of Hirons street. Another lock was also built and in this case a concrete collar was provided to prevent the air from escaping back over the lock and into the shaft. The shorter haul more than compensated for the cost of sinking the shaft. Work from here went on rather quickly and without any more accident. Toward the end of this section the greatest progress was reached, from 12 to 15 ft. of sewer being completed each day.

The needle-beam method of supporting the timbers was used throughout. Several of these beams broke, owing to the various accidents which lessened the air pressure in the tunnel and thus necessarily increased the weight on the beams. After each accident the size of the needle-beam was increased, until a 16 by 16-in. timber, reinforced on each side with steel plates, was used. Several times when the pressure was decreased the timbers in the crown of the tunnel settled so much that there was room only for one or two rings of brick. These places were built in temporarily, but when the rest of the sewer was complete they were opened up again, the timber raised and the brick work replaced correctly.

Considering the whole work, with the many difficulties overcome, the contractors, Messrs. Donnelly & Graham, deserve great credit for their spirit and perseverance.

The data here given were reported to the Canadian Engineer by W. G. Cameron, District Engineer, Sewer Section, Department of Works, Toronto, and Mr. Cameron furnished Municipal Engineering the views shown herewith.

Recommended Practice for Laying Sewer Pipe

A proposed revised tentative recommended practice for laying sewer pipe formed an important part of the report of Committee C-4 of the American Society for Testing Materials at the recent annual convention. The editor is advised by Edgar Marburg, secretary-treasurer of the society, that the recommendations were accepted by the society for publication among the tentative standards of the society, and it is probable they will be recommended for adoption as standard next year. The committee consists of 19 members. Rudolph Hering, consulting engineer, is chairman; A. J. Provost, Jr., consulting engineer, vice-chairman, and E. J. Fort of the Brooklyn sewer department is secretary. Pending the adoption of the recommendations as standard, engineers may safely regard them as indicative of the best practice in laying pipe sewers.

Preparing Trenches and Foundations for Pipe Laying

The foundations in the trench should be formed to prevent any subsequent settlement and thereby possibly an excessive pressure and consequent rupture of the pipes.

If the foundation is rock an equalizing bed of concrete or sand well compacted should be placed upon the rock. The thickness of these beds should not be less than 4 ins. Pipes should be laid in these beds so that at least the lower third of each pipe is supported its entire length.

If the foundation is good firm earth, the earth should be pared or molded to give a full support to the lower third of each pipe and, if necessary to secure proper bearing for the pipe, a layer of concrete, fine gravel or other suitable material should be placed. The same means of securing a firm foundation should be adopted in case the excavation has been made deeper than necessary.

If there is no good natural foundation, the pipes should be laid in a concrete cradle supported on a masonry foundation carried to a soil of satisfactory bearing power or supported on a structure designed to carry the weight of pipe and its load to a firm bearing.

Trenches should be kept free from water until the material in the joints and masonry has sufficiently hardened.

To protect pipe lines from unusual stresses all work should preferably be done in open trenches.

Pipe lines should be placed at a sufficient depth below the surface of the street to avoid dangerous pressure or impact. When this is not possible special reinforcement should be provided.

Trenches should be only of sufficient width to provide a free working space on each side of the pipe, according to the size of the pipe and the character of the ground, but in every case there should be sufficient space between the pipe and the sides of the trench to make it possible thoroughly to ram the backfilling around the pipe and to secure tight joints.

Pipe Laying.

The laying of pipes in finished trenches should be commenced at the lowest point, so that the spigot ends point in the direction of flow.

All pipes should be laid with ends abutting and true to line and grade. They should be fitted and matched so that when laid in the work they will form a sewer with a smooth and uniform invert.

It is necessary to use all possible care when shoving the pipes together, so that the joints will not be unnecesarily large.

Bells should be carefully cleaned before pipes are lowered into trenches. The pipes should be so lowered as to avoid unnecessary handling in the trench.

The pipes should be set firmly accordingly to line and grade, and the joints carefully adjusted and filled with the jointing material.

Joints should be made in the following manner: A closely twisted hemp or oakum gasket of suitable diameter, in no case less than ¾ in., and in one piece of sufficient length to pass around the pipe and lap at the top, should be solidly rammed into the annular spaces between the pipes with a suitable calking tool. When cement joints are used, the gasket should first be saturated with neat cement grout. The remainder of the space should then be completely filled with the jointing materials.

Back-Filling Trenches.

All trenches and excavations should be back-filled immediately after the pipes are laid therein, unless other protection of the pipe line is directed. The back-filling material should be selected and deposited with special reference to the future safety of the pipes. Clean earth, sand or rock dust should be solidly tamped about the pipes up to a level at least 2 ft. above the top of the pipes. This material should be carefully deposited in uniform layers. Unless otherwise permitted, each layer should be carefully and solidly tamped or rammed with proper tools so as not to injure or disturb the pipe line.

Puddling or water flooding for consolidating the back-filling is recommended only for sandy and gravelly materials. If this method is used, the first flooding should be applied after the back-filling has been compacted by tamping up to 2 ft. above the top of the pipes, and the second flooding during or after the subsequent filling of the trench. An excess of water should be avoided, in order to prevent disturbance of the earth under and around the pipes and also to prevent an undue excess of pressure upon them.

Walking or working on the completed sewer, except as may be necessary in tamping or back-filling, should not be permitted until the trench has been back-filled to a height of at least 2 ft. over the top of the pipes.

The filling of the trench should be carried on simultaneously on both sides of the pipes in such a manner that injurious side pressures do not occur.

Cost and Efficiency Comparison of Motor Trucking and Horse Haulage

In an investigation conducted at Bennington, Vt., it was found that H. W. Meyers & Son, dealers in coal and feed, have been effecting a saving of $11 a day in employing a two-ton Federal truck for making their deliveries.

This information was gained through accurate records of horse and truck operations covering a period of six months. It was further shown by these records that the Federal two-ton truck had performed 350 per cent more work than any of the firm's teams on the same type of deliveries. This has been accomplished at an additional cost of but 20 per cent over the expense of two horses.

Taking these figures as a basis, a two-ton truck performs the work of 3½ teams. The cost of the horses is figured at $178.13 a month, or $5.93 per day. Three and a half teams would cost $20.77 per day. The monthly cost of truck operation is put at $213.17, or $7.10 per day. Even including the wages of a helper on the truck this form of transportation would be $11 a day cheaper than by the use of teams for the same work.

Concreting in Cold Weather

Only a few years ago many contractors and other concrete workers thought it necessary to stop concrete work with the approach of cold weather. Today cold-weather concreting practice has become so standardized that in most localities concreting is carried on throughout the entire year. Protection of concrete work done in cold weather requires that means be used to duplicate summer temperature conditions in the concrete itself. This is done by heating all the materials, although there are occasions when only the mixing water need be heated.

PAVEMENT CLEANING AND MAINTENANCE

The Importance of Proper Maintenance of Country Roads

By J. D. Fauntleroy, District Engineer, United States Office of Public Roads.

Before building a road we should look ahead, past the construction period to the maintenance which is to follow after, and endeavor to get a mental vision of how that road should look two or three or ten years hence. This is not a matter of mere conjecture, but, from information in hand, knowing the traffic that will traverse a road, we can determine, within reasonable limits, what the life of any particular class of road will be, and can also in like manner determine what the cost of maintaining that road should be. With such knowledge available it is criminal folly to go ahead and construct roads that will not answer the traffic requirements and that will either fail utterly, leaving only the debt to show that they were once constructed, or else they will have to be, at a future date, reconstructed at a much higher cost than would be the case had they been properly constructed of suitable materials in the first place.

The Perfect Maintenance System Not Yet Found.

The question of maintenance is an old one. For the past 25 years different states have been experimenting and passing laws in the hope of successfully solving this problem. It cannot be said that any state so far has developed a perfect system of maintenance. We know that in certain sections of a state, for example, the roads will be better maintained than in other sections, and the only way we can account for it is that in some counties the men in charge of the road work are more conscientious and develop more efficient methods than the road supervisors in other counties.

I know a county in Texas which, without the aid of any bond issues, has succeeded in putting its main roads in very creditable condition, because its road overseers have tried honestly and faithfully to make every dollar go as far as possible, and have tried to handle the road business as though it were their own private enterprise. Very close to this county is another county, wherein all of the road funds have been expended and over $100,000 of "anticipation warrants" have been issued for the purpose of road improvement, and the roads are in a most wretched shape. This indicates indifference and neglect on the part of the officials of that county.

Personal Interest All-Important in Road Maintenance

I do not know of any business wherein personal interest and intelligence will count for more than in the maintenance of rural roads. Take, for example, the dragging of roads. Some men will take a road machine or a light drag and go out over a road during a rain or immediately after it, and in the course of a few hours it will look splendid, with the ditches cleaned out and the crown properly shaped. On the contrary, many men, when employed to drag a road, will defer this very necessary operation until the road is baked hard and dry and ruts are all over it, and as a result dragging is practically useless. You can put it down as a fact that when a man takes the seat off his wagon and places it on the road drag, he is no good as a road man, and to any one who really wants to see a road improved it is exasperating in the extreme to see such a man dragging the road, with the horses going aimlessly ahead, while he dozes contentedly on his seat.

To handle a drag properly and get the best results, a man must be on the alert, stepping from one side of the drag to the other and occasionally getting off, and even lifting one side of the drag in order that he may secure a proper crown to his road.

I know of many cases where the present county funds not only suffice to maintain the roads, but the roads are being gradually improved all the time. I know of an eastern state wherein, by a system of careful maintenance, the unimproved state highways have been turned into very creditable roads, tho no actual construction or reconstruction work has been done. This was done by cutting off a bump here, straightening out a sharp bend there, replacing temporary bridges with permanent drainage structures, and keeping the road well bedded up and thoroughly drained.

On the contrary, I know of a county in west Texas where a road needed only about a half day's work with a road machine to put it in good condition, and a number of road hands proceeded to plow up the entire road, thereby destroying the hard surface which the road had. The result of their three days' work was to utterly ruin one mile of road. It will take fully $500 to put this road back into proper shape.

Good Maintenance Condition Precedent to Federal Aid

On all work where federal aid money is solicited we require resolutions from the local board stating that the road will be maintained, and when I have appeared before such boards and explained that such resolutions must be forthcoming, they have invariably answered me promptly that adequate financial arrangements would be made. I believe it is always better to have a clear understanding beforehand, rather than an unpleasant settlement afterwards, and for this reason I have asked these local boards in just what manner they were going to maintain these roads, and their answers have invariably been that the local road supervisor or overseer would see that the roads were maintained. I have then asked them if this road overseer or road supervisor was a skilled man and if the roads under his charge at the present time were properly maintained. This latter question was generally a facer to them, and they had to acknowledge that their roads were not efficiently maintained. Then I have explained to them that the proper maintenance of a road means the providing of an adequate organization to maintain the road; that some man must be definitely responsible for the road at all times, and that it is much better to have one conscientious man devote his whole time to road work and to know that he has a sure means of livelihood so long as he performs his duties, than to work the road spasmodically with gangs of men who have little interest in such work.

Cantonment Road Building in Record Time

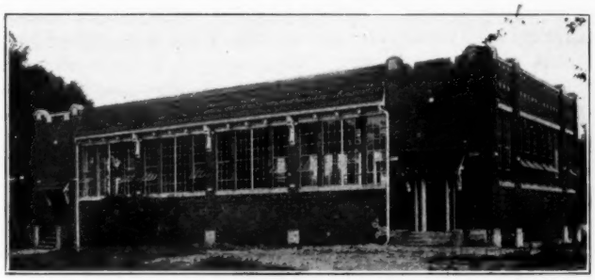
A record-breaking piece of road building was completed recently in connection with the army cantonment near Louisville, Ky. This is one of the few military establishments that have built permanent roads. In 63 working days the contractor completed 63,360 sq. yds. of Trinidad asphaltic concrete highway laid on a concrete base, or about 6 miles of road 18 ft. wide. A mile of the road was over a 4-ft. fill, and immediately upon its completion a traffic count showed that 4,000 vehicles passed over it within the first hour. Most of these vehicles were motor trucks and wagons carrying loads of from one to five tons.

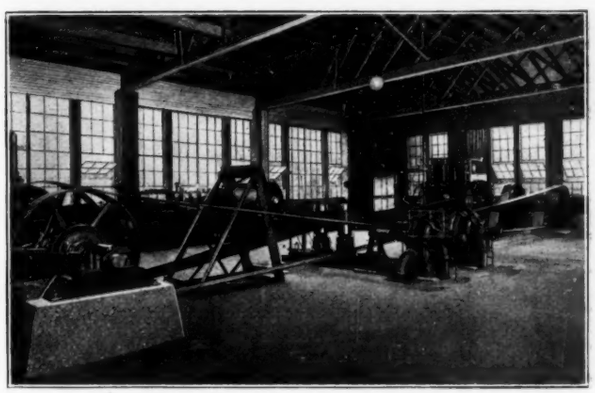
WATER WORKS DESIGN AND CONSTRUCTION

Extensive Water Works Reconstruction at Wheaton, Ill.

Reconstruction of the Wheaton, Ill., municipally owned water works system was completed about two months ago. The source of supply is two 10-in. wells, drilled to a depth of approximately 250 ft., penetrating a limestone formation.

These wells are located approximately 30 ft. apart. A dry well was sunk to a depth of approximately 33 ft. below the basement or lower floor level, in which is installed two vertical turbine type American Well Works pumps. The suctions



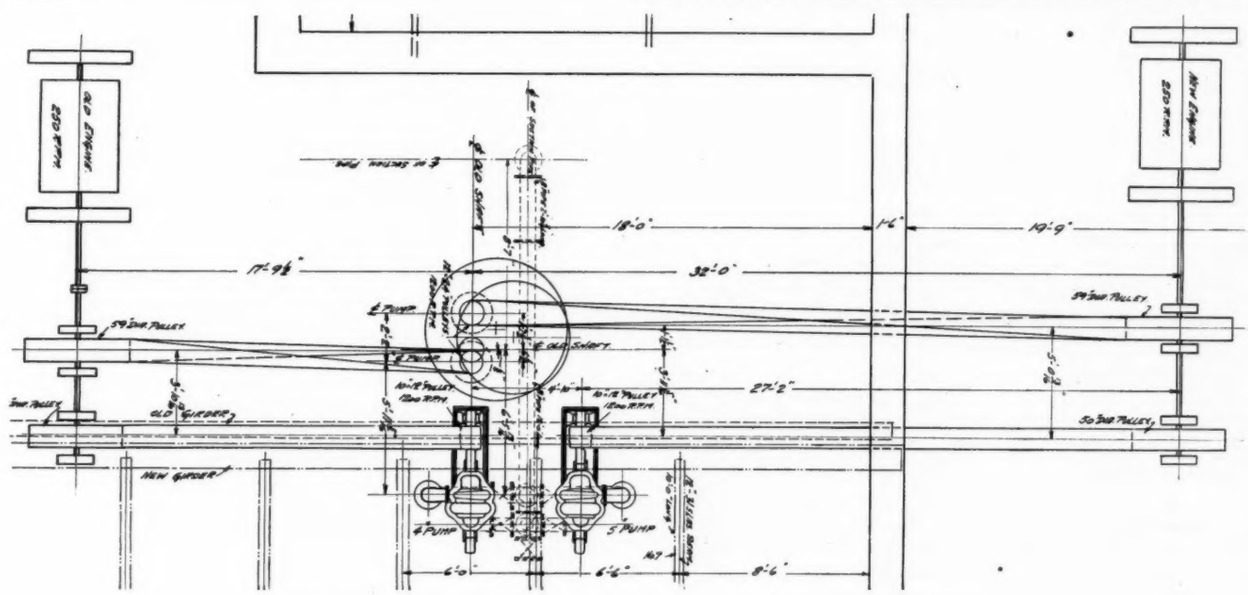


EXTERIOR AND INTERIOR VIEWS OF NEW WATER WORKS PUMPING STATION, WHEATON, ILL.

of these pumps are connected thru tunnels to each of the 10-in. wells. Each pump is provided with all necessary shafting, bearings, etc., together with a steel frame, which is carried to the second floor and fitted with a vertical pulley. One pump is operated thru one-quarter turn belt by a 60-h.p. Nash producer gas engine; the other is operated by a 100-h.p. Nash producer gas engine.

also installed in this plant two "American" horizontal 2-stage diffuser type centrifugal pumps, one designed to have a capacity of 500 g.p.m. when working under a total head of 210 ft. When drawing water from the surface reservoir and discharging into the distributing system and elevated tank this pump is operated by the 60-h.p. engine. The second horizontal pump is designed to have a capacity of 750 g.p.m. when working under a total head of 210 ft.; service is the same as 500-gal. unit. The mechanical efficiency of both of the horizontal pumps is 72 per cent.

In 1912 the city of Wheaton installed the 60-h.p. Nash producer gas engine referred to for operating two centrifugal pumps, one pump being installed in a dry well drawing water



PLAN OF LAYOUT OF NEW PUMPING MACHINERY, WHEATON, ILL.

These pumps deliver water from the wells mentioned to a surface reservoir. Each pump is designed for delivering 750 g.p.m. when working under a total head of 70 ft. When pump is operated at rated capacity 22-in. vacuum is carried. The mechanical efficiency of these pumps is 70 per cent. There is

from the two 10-in. wells, having a capacity of 750 g.p.m. when operating under a total head of 70 ft.; one 2-stage horizontal centrifugal pump, type "K," designed to have a capacity of 500 g.p.m. when operating under a total head of 160 ft., but owing to the increase in population it was found necessary to

increase the capacity of this plant, also to make provision for duplicate equipment. The citizens of this city voted a bond issue of $35,000 for this improvement.

A new elevated tank, having a capacity of 200,000 gals., was installed at a higher elevation than the former standpipe, which has been removed, and two special type vertical pumps

LOOKING DOWN INTO THE 33-FT. PUMP PUT OF THE WHEATON WATER WORKS.

were designed so they could be installed in dry well in place of one. The dry well was not perfectly plump and straight, which necessitated the construction of special equipment, illustrated herewith.

The old steam plant, which formerly had been held as an auxiliary, was removed and a new building of modern design erected, consisting of lower floor or basement, which includes supply room, producer room and coal room. The main floor consists of engine, pump room and office. This plant, from the time first pumps were installed, has not only proven efficient, but absolutely reliable. The daily consumption is 350,000 gals., there being 1,050 service connections.

Joining Cast Iron Water Mains with Cement

Cast lead joints for cast iron water mains have been the regulation type for many years, altho in recent years many miles of big pipe have been pneumatically caulked with lead wool. Latterly cement joints have been successfully employed for this purpose, and approved procedure in this connection was recently described by Clark H. Shaw in a paper before the American Society of Civil Engineers, substantially as follows:

The pipe is placed in the usual manner. A thin backing of the best dry jute is used instead of oakum, as the jute is free from oil and grease, which should be avoided. Portland cement conforming to the specifications advocated by the American Society for Testing Materials is placed dry on a piece of canvas and moistened. When thoroly mixed by hand it should be of such a consistence that when gripped tight it will take the form of the hand and when dropped 12 in. will crumble. The canvas containing the cement is placed under the bell, and the cement tamped into place by hand with a caulking iron until the bell is about half full. It is then caulked with heavy blows until the cement is packed thoroly in the back of the socket. The process is continued until the bell is packed solid. A small bead of cement is then added, the caulking iron being used as a trowel. As soon as the initial set of the cement in the bead has taken place, the joint is covered with earth to protect it from the air and sun.

The bead is regarded as essential because the cement packed in the bell is so dry that without protection it would absorb moisture from the water used in settling the trench. It is believed that, should the joint develop seepage when the main is placed under pressure, the cement, being dry, would expand and aid in keeping the joint tight. The joint is allowed to stand 48 hours before it is placed under pressure and the main put into regular service. Cement joints have, however, been used with satisfactory results 12 hours after completion, but this is not recommended.

At Long Beach, Cal., there are 60 miles of cast iron water mains, ranging from 4 to 24 in. diameter, laid with joints of this type. These mains are under pressures ranging from 40 to 80 lbs. per sq. in., and are giving perfect satisfaction.

Refuse Collection and Disposal

Toronto Incinerator Exceeds Burning Capacity Guarantee by 133 Per Cent

The Don incinerator plant of the city of Toronto was recently completed and is now being operated by the department of street cleaning of which J. A. Burnett is engineer. The building is of fire-proof construction throughout and cost about $200,000. In plan it is 151 ft. by 81½ ft. It has five floors known as the tipping, charging, stoking, main and ash-run floors respectively. Collection wagons are driven directly upon the tipping floor. The charging floor is 9 ft. lower than the tipping floor and is located on the west side of the building, while the tipping floor is on the east side. The main or ground floor is 33 ft. below the tipping floor. Seven feet above the main floor and on the extreme west side of the building is the stoking floor, from which the furnaces are stoked and cleaned. Below the stoking floor is the ash floor, along which the residue from the furnaces is cleaned, as reported by Mr. Burnett in the Contract Record of Toronto.

On the northwest corner of the main building a wing is built which is known as the ash building. This portion of the plant is equipped with a large steel ash bin, suspended from the ground floor into which the residue from the furnaces is discharged; the bin is approximately 10 ft. above ground level, which permits the residue to be loaded into railway cars or team wagons as desired. A railway siding is brought into the plant and passes under and through the ash building.

The plant is equipped with three high temperature Sterling furnaces of modern design which were installed and guaranteed by the Canadian Griscom-Russell Co., Ltd. The furnaces are of the top-fed continuous-grate, regenerative type. They are each constructed with four cells, which are charged and cleaned individually. At the extreme end of the grates a spacious combustion and settling chamber is constructed. The by-pass flue, over which the regenerator chamber is built, completes the furnace construction. An elevated flue connects the furnaces with the main flue which in turn, is connected to the chimney.

High Temperatures Remove Odor

Each furnace has a total area of 100 sq. ft., the cells each containing 25 sq. ft. The guaranteed burning capacity was 50 lbs. of refuse per sq. ft. of grate area per hour, when burning material containing not more than 940 lbs. of water per ton of 2,000 lbs. and not less than 460 lbs. of combustible per ton. The furnaces are designed and constructed for high temperatures, the specified temperature requirements being such that the combustion chamber temperature shall not fall below 1,250 degrees F. for more than three minutes in any one hour, and that an average temperature of at least 1,400 degrees F. be maintained therein. From the requirements it may be readily seen that any objection due to the presence of obnoxious gases is entirely eliminated, as gases generated from the incineration of garbage are rendered odorless at a temperature of about 1,050 degrees F. Thus a leeway of at least 200 degrees F. is afforded. The temperatures are registered continuously on a chart by means of electrical recording pyrometers. An effective, superheated, forced draft system is embodied in the construction of each furnace, the draft being generated by means of direct-connected, motor-driven fans. The air, drawn from the top of the furnace front by the fan, is forced into the regenerator, which is similar in action to that of a vertical boiler. It consists of cast iron tube plates, top and bottom, which support a series of cast iron tubes inside the chamber. A portion of the hot gases from the combustion chamber passes through the tubes and discharges into the connecting flue. The air from the fan circulates around the outside of these tubes, it being baffled in many places. During this process the air is raised in temperature from that of the room to approximately 300 degrees F. The hot blast discharging from the regenerator passes through sheet metal piping, which connects with the air duct under the grates. Suitable valves are provided, and the admission of air under the grates is regulated conveniently from the stoking floor.

Charging Devices Operated by Hydraulic Rams

The charging devices for the cells are mounted on the top of each furnace, and consist of a steel container with bottom dump doors, into which the material is fed. The container doors and furnace charging doors are opened and closed mechanically, this being effected by the use of hydraulic rams, to which the doors are connected. The rams operate under city water pressure, and are controlled from the stoking floor level. Each furnace is equipped with individual dampers, which permit the shutting down of any furnace without influencing the operation of the others. Clean-out doors of ample size are spaced at frequent intervals throughout the different chambers and flues, which allow the various parts to be readily cleaned.

The furnaces and flues are constructed with common brickwork of sufficient thickness, the outside face walls being built of salt glazed brick laid in cement mortor. The non-absorbing nature of these bricks permits the washing-down of the brickwork, and the glazed surface will not readily hold the fine dust, so that the furnaces can always be maintained in a clean and sanitary condition. The furnaces and flues throughout are lined with firebrick of first-class quality, at least 9 ins. in thickness, with a minimum air space of ¾ in. between the firebrick lining and the brick walls. Heavy structural steel buckstays are spaced at suitable intervals, connected with large size tie-rods, for supporting the masonry of the various parts subjected to temperature strains. The radial brick chimney is lined with firebrick for its full height of 175 ft.

Plant Operation

The operation of the plant is very simple and effective. The material is delivered to the plant in the street cleaning department's new type of general-purpose single-horse wagons, and enters the building from the south end, after being weighed on a scale. The wagons are backed against the bumper beam on the tipping floor, and the contents dumped on the charging floor, after which the wagons leave and disperse along the several streets in close proximity to the plant. From the charging floor the material is fed into the containers by the charging men. The containers are operated by the stokers below. The material which is charged into the furnaces drops on a drying hearth at the back of the grates and is then drawn over on the grates, where incineration takes place. The flame and hot gases pass into the combustion chamber, where complete combustion is effected. The heavy dust falls into the bottom of this chamber and is removed through the clean-out doors. At the end of the combustion chamber a firebrick dividing arch is built, which splits the gases leaving the combustion chamber, of which a requisite portion passes on top into the regenerating chamber, while the remainder passes through the bypass flue below the regenerator. from these points the gases enter the up-takes to the connect-flues and thence through the main flue into the chimney.

Removal of Residue

The residue is drawn from the grates through large doors on the furnace fronts and is dropped into dump cars located in the ash-run and operated on a narrow-guage track. Trap-doors in the stoking floor are provided for this purpose, these being closed except when cleaning operations are in progress. The cars are moved to the north end of the ash-run and placed bodily upon an electrically-operated elevator, raised to the bin tipping floor level, when the car is moved over and the residue dumped into the ash bin. This ash bin is equipped with a series of adjustable doors, thus allowing the further removal of residue from the plant in any desired manner.

The Test

During the months of April and May the contractors conducted the required test of 30 days' duration, operating under the normal conditions, during which time the capacity of the plant was judged. On June 28 the official capacity and acceptance test was conducted. Observations were made and readings taken at frequent intervals. Previous to making the test the furnaces were operated for a period of about five hours, for the purpose of raising and maintaining the temperature throughout the furnaces and flues. Observations were made at the time of starting and completing the test, to ascertain the conditions of grates and containers, so as to insure the same cycle of incineration. Requirements referring to density of smoke, analysis of residue and emission of dust from chimney, were found to be satisfactory during the test. The high rate of burning, 116.5 lbs. per sq. ft. of grate area per hour exceeded the guarantee of 50 lbs. by 133 per cent.

Owing to the increased rate of incineration over the estimated amount, the mode of operation has been affected somewhat. The original intention was to operate the plant on a two-unit, day and night shift, basis, which was calculated to dispose of an average of 100 tons of material daily, but it has been found economical to operate the plant on a day shift basis only with the three furnaces burning, especially as the efficiency of the plant has been equally maintained under normal conditions, operated under the supervision of the department. This system has many advantages over the day and night shift basis. First, the life of furnaces will be greater, as temperatures are maintained in a more regular manner and the number of times the furnaces are shut down is reduced to a minimum. Thus strains caused by expansion and contraction are eliminated to the least possible degree; also the most effective and economical method of disposal of garbage by incineration is to reduce the time of storage to a minimum, as otherwise it becomes packed and thereby more expensive to move. Under the present mode of operation an

average of 100 tons of material daily is being disposed of during the day only. Two men are engaged during the night removing the residue from the grates into the ash bin, which permits burning immediately upon starting the next morning. A staff of 1 foreman, 6 stokers, aand 20 laborers constitute the labor requirements for operating the plant. Experiments are now being conducted with a view to reducing the labor at present required, which is not as effective, due to war conditions, as would otherwise be the case.

Bids for Removal of Wastes from Ayer Cantonment Vary Widely

The various army cantonments are essentially cities and interest attaches to the handling of the refuse produced. The cantonment division of the War Department has awarded the contract for the removal of all garbage and waste from the Ayer cantonment to the S. A. Megher Company, soap manufacturers, of Milton, Mass., this firm having been the highest bidder, offering the government $21,600 for the privilege of carting the refuse away.

The ten bids received were exceedingly diverse in their terms. The lowest bidder asked the government to pay him $72,000 for doing the work. Others asked smaller sums, and still others offered the government money for the privilege. The second highest bidder was the Eastern Oil and Rendering Company, with offices at 92 State street, Boston, which bid $7,600 for the privilege of doing the work.

The lowest bidder—that is, the one who asked the government to pay $72,000 for the work—was the Boston Development and Sanitary Company, the firm which now has the contract for removing refuse for the city of Boston. Certain credits which this concern proposed to allow would have amounted to approximately $10,000 per annum, so that the net cost to the government would have been about $62,000, a net loss of about $80,000 as compared with the bid of the successful contractor.

The successful bidder was required to furnish a bond of $25,000 for the faithful performance of the contract, and is required to remove twice daily from the camp about 70 tons of manure, 10 tons of kitchen garbage, to say nothing of a large quantity of tin cans, waste paper, fat, bones, grease, dead animals and other refuse.

Under the terms of the contract he must supply all containers for garbage and other refuse and must make two removals daily for the period of one year, beginning September 1, 1917. The government reserves the right to cancel the contract on thirty days' notice.

WATER PURIFICATION AND SEWAGE TREATMENT

Various Methods of Dewatering Activated Sludge

By Edward Bartow, Chief Water Survey Division, University of Illinois, Urbana.

Satisfactory purification of sewage by aeration in the presence of activated sludge has been obtained by us and by many others, but before the method can be considered an unqualified success a practical and economical method of drying the sludge must be found. Various methods have been tried by different investigators, but we have at the risk of duplication experimented with many of these methods at our sewage experiment station, said Dr. Bartow in addressing the American Institute of Chemical Engineers.

Drying on Sand Beds.

Although drying on sandbeds had been tried at Cleveland and we had ourselves tried it, we thought wise to repeat the experiments on better constructed beds than were used in our previous work. The experiments were not successful. Owing to the large amount of moisture in the sludge, 98 to 99 per cent, the solid matter obtainable from a foot depth of sludge would be only from ¼ to ½-in., according to the residual moisture content. It was also difficult to separate the sludge and sand. The fertilizer obtained was more or less impure and of decreased value. The sand beds used were one-hundredth of an acre in area and divided into five compartments. Underdrains were overlain with 10 ins. of coarse gravel and 8 ins. of sand. The beds were provided with a canvas cover supported on a frame work so that they could be protected during storms. One compartment was allowed to dry after a single filling, another after two fillings and another after three fillings. In no case were the results sufficiently satisfactory to warrant the use of sandbeds for the drying of the sludge and the production of a commercial fertilizer.

Filter Pressing.

Experiments with a filter press with leaves 8½ in. square operating on a fairly concentrated sludge were also unsatisfactory. It has thus far been impossible for us to obtain a cake of good consistency. Further experiments are to be tried with the hope that better results can be obtained.

Use of Rotary Filter.

Through the courtesy of the Koering Cyaniding Company of Detroit a rotary filter was placed at our disposal. This style of filter is used satisfactorily in filtering slimes in extracting gold and silver by the cyaniding process. The apparatus consists of a cylinder of filtros plates supported on a perforated steel cylinder outside of which at a distance of about 1 in. is a solid steel outer shell. The material to be filtered is forced into the interior of the cylinder of filtros plates, the cylinder is revolved and a cake of sludge is built up on the inside of the plates. The liquid filters through the plates into the space between the cylinders. Air pressure can be exerted from the interior to dry the cake, and from the exterior to loosen it. The plates can be cleaned by back-flushing with water. The first trial with a comparatively heavy and not very fresh sludge did not give satisfactory results. The quick-opening door could not stand the pressure. Another trial will be given as soon as the door can be replaced.

Using Centrifuges.

Mohlman reported experiments with two small centrifuges, one of the low-speed basket type and the other of the high-speed bottle type. The basket of the low-speed machine was 8 ins. in diameter and 6 ins. deep. The periphery was perforated with numerous holes 1/16 in. in diameter. When the holes were covered with a strip of muslin cloth, approximately 1 gal. of 98 per cent moisture sludge was put into the centrifuge and after 15 minutes, 700 grams of 91 per cent moisture sludge were obtained. The high-speed bottle-type machine reduced the moisture from 98 per cent to 92 per cent in three minutes. Mohlman stated that in order to be economical there should be an automatic arrangement for removing the cake.

The most successful apparatus of this type is the Schafer-ter Meer centrifuge described by Hammond. This machine is said to be very efficient but was too expensive for us to obtain for experimental work.

At Cleveland, Pratt and Gascoigne used a laundry centrifuge with a 26-in. basket, lined with a ¼-in. wire mesh inside of which was a canvas bag. In the best run, when the basket revolved about 1,200 revolutions per minute, 60 gals. of 97½ per cent moisture sludge was added in about 25 minutes, and in 2 hours the moisture content was reduced to 84 per cent. The time required would seem to make this process impracticable.

Working on the assumption that the principle used in drying of china clays or that used in the cream separator might be applicable, a modified basket-type centrifuge and a modified cream separator were tried. The holes of an 8 in. basket centrifuge were covered with a strip of rubber packing. The best results were obtained with 1,500 revolutions per minute, which was the limiting speed of the machine. This would seem to indicate that the process would give efficient results if carried on at an increased speed, but would yield an effluent that must be returned with the sewage to the aeration chamber. A series of tests was made with a cream separator, the bowl of which was modified, by removing the inner disks and discharging the clarified liquid about an inch from the center of the bowl at the top. The sludge added at the top dropped to the bottom of the bowl, and the liquid was thrown over the rim. Sludge cakes containing from 85 to 86 per cent of moisture were obtained by the cream separator in 6 to 8 minutes, which encouraged us to obtain a special machine for further experiments.

A Specially Designed Centrifuge.

A specially designed centrifuge was purchased from the Tolhurst Machine Works of Troy, N. Y. This machine is 12 ins. in diameter, 9½ ins. high and at a speed of 1,800 exerts a centrifugal force of 550 lbs. According to its concentration from 10 to 25 gals. of the sludge are added and 10 lbs. of cake obtained. The sludge cake contains about 88 per cent moisture. The space underneath the rim contains 0.158 cu. ft. Owing to the small size of the machine and to the fact that the material must be scraped out, the time of cleaning is longer than would be required for a larger machine with an opening in the bottom, so that a large machine could undoubtedly have been filled and emptied more rapidly than the small laboratory machine. We have found it entirely possible to fill and empty the small machine four times in one hour. Calculating that the same rate could be used with a 40-in. machine having 46 times the capacity, we could obtain in each filling 460 lbs. of sludge of 88 per cent moisture, equivalent to 55 lbs. of dry material. One 40-in. machine would, therefore, deliver the equivalent of 2,200 lbs. of dry material in a working day of 10 hours. On the supposition that ½ ton of dry material will be obtained from 1,000,000 gals. of sewage, one machine would dewater the sludge from 2,000,000 gals. of sewage per day. The cost of the 40-in. machine at present is only $750 and the power to run it is small enough to make the process appear practical for preparing sludge cake for a dryer.

Cost.

The actual cost of dewatering will depend upon the amount of water that can be removed by the centrifuge, the size of dryer and the amount of coal required for removing the residual water. A drying test using 220 lbs. of 88 per cent sludge cake made by the John P. Devine Company indicates that the dewatering process can be made practical.

WATER WORKS MAINTENANCE AND OPERATION

Official Duty Tests of Steam Turbine Driven Centrifugal Pumps at Sixty-eighth Street Pumping Station, Chicago

Official duty tests of the two 30,000,000-gal. steam turbine-driven centrifugal pumps at the 68th Street pumping station of the Chicago water works were recently made and have just been made public. These pumps with their accessories are the first of their type to be installed in Chicago. Owing to this fact, an effort was made to obtain all possible data on the performance of the various portions of the apparatus and to present this information in a form useful in future designs for similar installations. The results of the tests show that all of the guarantees were met and that the installation is in general conformity with the terms of the contract and specifications. The pumps were installed under a contract by William A. Pope and were tested by three experts: William A. Nelson, for Chicago; R. W. Allerton, for the contractor, and C. J. Bacon, a third expert, chosen by the other two.

Description of Pumping Machinery.

The equipment installed under this contract consists of two duplicate steam turbine-driven centrifugal pumps, complete with all auxiliaries, venturi meters, steam flow meters and other appurtenances. The accompanying half-tone shows the general arrangement.

The rated capacity of each pump is 30,000,000 gals. per day against a head of 140 ft. Each pump has its own suction well from which the water is drawn through an Elliott twin strainer and then through a suction surface condenser before reaching the pumps.

The water leaving the pump passes through a venturi meter which is preceded in the discharge line by a straight pipe of suitable length to insure the proper operation of the meter. The down-stream portion of the meter has a long radius bend and leads directly to a large multiple disc check valve beyond which is a hydraulically operated shut-off valve.

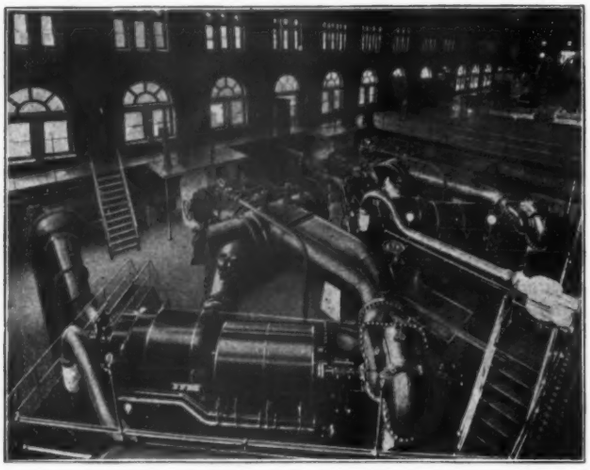
The pump proper is a Worthington horizontal, single impeller, double-suction type without diffusion blades, and is driven through reduction gearing by a steam turbine. The pump, reduction gear and turbine are all mounted on a single sole plate to insure rigidity of alignment.

The turbine is a Kerr "economy type," horizontal, condensing, multistage, nozzle and blade impulse machine with parallel steam flow. It is provided with an oil-relay speed control governor, a constant water pressure governor and also an emergency overspeed governor arranged to trip a steam operated stop valve in the steam supply pipe.

Forced lubrication is provided for the main turbine bearings and for the reduction gear bearings. The return oil is cooled by water circulating pipes in an oil reservoir located in the base of the turbine. There are no steam-driven auxiliaries, both the air and hot well pumps being hydraulically driven.

There is a Worthington hydraulic vacuum pump, using water taken from the main pump discharge line for ejecting the non-condensible vapors from the condenser. As the discharge from the air pump is not contaminated with oil or other objectionable impurities, it is conducted back to the main suction well. Provision is made for obtaining water from other sources in case of starting up or in emergency.

The hot well is drained by a vertical shaft, four-stage, centrifugal pump, direct driven by a pelton wheel. The water required for operation is obtained from the same source as that for the air pump.



VIEW OF TWO STEAM TURBINE DRIVEN CENTRIFUGAL PUMPS AT 68TH ST. STATION, CHICAGO.

The following table gives the principal dimensions and other data relating to the units:

Main Pumping Unit.

Length over all, feet and inches	25-6
Width over all, feet and inches	7-1
Height over all, feet and inches	7-6
Total weight of unit in pounds	64,000
Total weight of sole plate for entire unit, pounds	15,000

Centrifugal Pump.

Make of pump	Henry R. Worthington
Normal speed of pump, r.p.m.	720
Diameter of impeller, in inches	33.5
Diameter of shaft at impeller, in inches	5.5
Diameter and length of each bearing bushing, ins	5x13
Total projected area of pump bearings, square inches	130
Average unit pressure in pounds per square inch on bearings when operating under normal conditions	15.5
Length of pump shaft center to center of bearings in inches	84
Diameter of suction inlet, in inches	36
Diameter of discharge outlet, in inches	30
Net weight of pump without sole plate, in pounds	20,200

Steam Turbine.

Make of turbine	Kerr "Economy"
Brake horse power of turbine	913
Number of stages	14
Number and diameter of rotors	5-21 ins., 5-28 ins., 4-35 ins.
Speed of turbine(normal), rev. per min	3,740
Diameter of steam admission, in inches	5
Diameter of exhaust, in inches	36
Net weight of turbine without sole plate, in pounds	18,000

The reduction gears are of "Economy" type and were made by the Kerr Turbine Company. They are 20-in. involute and have a mechanical efficiency of 98.8 per cent. They consume 11 horse power when operating under normal conditions.

Object of Tests.

The object of the tests was to determine whether or not the machinery complied with the requirements of the specifications and with the contractor's duty guarantee.

The contractor's guarantee as included in his proposal and embodied in the contract is quoted here as follows:

Contractor's Guarantee.

"That: The undersigned that each pumping unit will develop a duty of not less than 129,000,000 ft. lbs. of work per 1,000 lbs. of steam of quality not less than 98 per cent dry when pumping at the rate of 30,000,000 gals. of water per 24 hours against a head of 140 ft. (not including friction head through pump and through suction and discharge piping between suction and discharge pressure gauges, as indicated on city's drawings), and supplied with steam at turbine throttle at a gage pressure of 175 lbs. per sq. in."

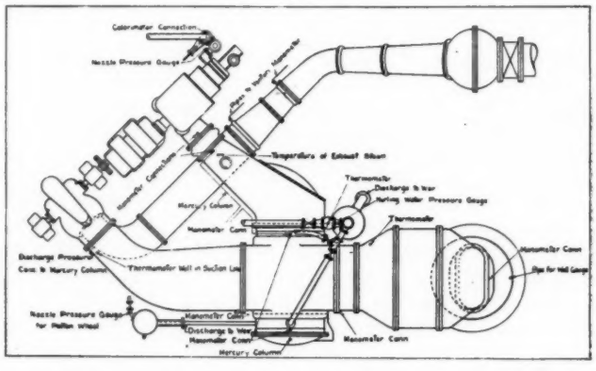
Method of Conducting Tests.

As the two units are duplicates, it was decided to investigate the performances of one pump throughout the entire available range of head and capacity and at different speeds, getting all possible information regarding the power required for auxiliaries and other data. The tests of the other pump were made only over sufficient range to determine its performance at and near the guarantee conditions. The location of the testing apparatus is shown in the accompanying cut.

The more elaborate series of tests was conducted on pump No. 2 as the arrangement permitted more convenience in installing the testing apparatus.

In the case of pump No. 2 twelve runs were made, as follows: One 4-hour run at as near the guarantee point as conditions permitted; two 2-hour runs at slightly above and below the guarantee head, respectively; seven 1-hour runs over as wide a range as possible; and two short runs at maximum and minimum head. These were necessarily of short duration.

Pump No. 1 was tested at three points, one 4-hour run being made at approximately the guarantee point and two 1-hour runs made at points above and below the guarantee points, respectively.



PLAN SHOWING LOCATION OF TESTING APPARATUS.

Owing to somewhat adverse operating conditions, it was impossible to obtain steam of the specified pressure of 175 lbs. at the throttle, the actual pressure averaging around 12 lbs. lower than specified. On this account it was decided to proceed with the tests with the object of approaching as nearly as possible to the guarantee point, by utilizing the maximum steam pressure available, and apply the necessary corrections to the results obtained.

Conclusions.

On official test of pumping unit No. 1, the results obtained at the specified head of 140 ft. were as follows:

	Guaranteed	Obtained
Capacity—1,000,000 gals. per 24 hours	30.0	30.8
Duty—1,000,000 ft. lbs. per 1,000 lbs. steam	129.0	132.0

On official test of pumping unit No. 2, the results obtained at the specified head of 140 ft. were as follows:

	Guaranteed	Obtained
Capacity—1,000,000 gals. per 24 hours.....	30.0	33.85
Duty—1,000,000 ft. lbs. per 1,000 lbs. steam..	129.0	135.50

The installation fully complied with all the requirements of the contract and specifications under the scope of the board of experts authorized to conduct the official tests.

Does Installation of Water Meters Affect Public Health?

The oldest objection to metering a public water supply rests on misinformation. Wherever meterage is proposed its advocates must contend with the fallacious belief that the introduction of meters so curtails the legitimate use of water that the public health is impaired. Commenting on this topic, M. Z. Bair, principal assistant engineer, Ohio state department of health, says:

It is my opinion that the metering of water has only an indirect effect upon public health. It does not seem possible that the limited use of water which might result from the installation of meters would in any way affect the health of the consumers. The most interesting example of the effect of metering that has come to my attention was the case of Cambridge, Ohio, which recently placed in operation a modern purification plant, replacing a grossly polluted and most unattractive supply. The water purification plant was designed for 2,250,000 gals., and following its installation the water consumption at times reached 3,000,000 gals., making it necessary to resort to the use of an unsafe emergency supply. If meters had been installed it is quite likely that the capacity of the water purification plant would not have been exceeded and the consumers would not have been endangered by the use of an unsafe emergency supply. I understand that this condition is being corrected by the rapid installation of meters.

In conclusion, I wish to say that the division of sanitary engineering of this department has always recommended the installation of meters, as we feel that is is the only fair and efficient way in which to sell water.

Springfield, Mass., Avoids Frozen Water Meters

By the use of properly designed meter boxes the city of Springfield, Mass., has entirely done away with those losses and inconveniences that result from frozen water meters. The Springfield Water Department uses a double cover box, installing 20-inch covers for all sizes of meters up to 1 inch. This gives ample air space between the risers and walls of the box. During the winter when the official tests were taken, the frost penetrated to the depth of 6 feet, but there was not a single frozen meter among the ones installed in the "Wabash" double-covered boxes. At the same time there were several hundred frozen meters among those set in basements.

BRIDGES AND BUILDINGS

New Bridge Designs of the Minnesota Highway Commission

Two new designs for highway bridges are reported by Carl E. Nagel, deputy state engineer of Minnesota, in charge of bridge work. These designs are a new cellular slab bridge and a concrete pile trestle bridge.

New Cellular Slab Bridge

On account of the increase in the price of steel, the I-beam span bridge with a concrete floor has advanced considerably in cost, and where the commission have furnished plans for his type and also for the flat slab reinforced concrete bridge, to be bid on at the same time, they found that in most cases the bids on the concrete bridge were nearly as low or lower than on the steel type.

In this solid slab type the great weight of the concrete contained is serious for several reasons. In the case of the 23-ft. span, 70 per cent of the strength of the bridge is required to carry the weight of the superstructure and 30 per cent to carry the traction engine. Another disadvantage is the difficulty of supporting the concrete when poured in the forms. In many cases not enough support has been supplied and the temporary false work has settled under the load of the concrete, resulting in actual damage to the strength of the bridge, as well as giving an unsightly appearance to the structure.

As about 50 per cent of the bridges for which the commission have furnished plans are 30 ft. or less in length or combinations of such short spans, they have given special study to such spans and have designed a new type of construction, which is still more economical than the flat slab superstructure, as well as being lighter and thereby avoiding some of the difficulties encountered with the solid slab.

The new type is cored out on the under side by semicircular arches of corrugated metal which form longitudinal reinforced concrete tee-beams, with cross beams, as shown in the accompanying cut, which is a plan for a half size model of a 23-ft. span, 18-ft. roadway bridge. This type uses one-third less concrete than the flat slab design and the forms are cheaper, as the corrugated metal arches are removed after the concrete has set and can be used repeatedly.

Concrete Pile Trestle Bridges

The most common cause for replacing old bridges has been on account of the old abutments and piers being in very bad condition. It is also true that most of the superstructures were too light to be worth reusing but they might have served for several more years for ordinary wagon loads.

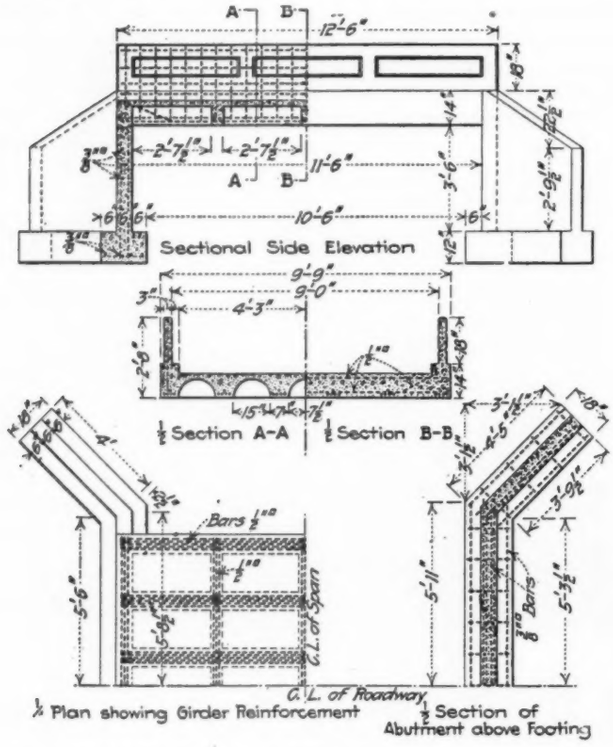
Owing to the limited funds available when these bridges were built, they were made considerably less expensive in first cost by not carrying the footings down well below the bed of the stream. Later the channel changed its course, so that the deepest part came over against one of the abutments or sometimes the whole bed of the stream was gradually cut out and lowered so that the abutments were undermined.

In the state plans for bridges the abutments and piers are carried down below probable undermining at a consequent increase in cost for abutment work.

In the commission's search for a type of substructure that would be less expensive and at the same time provide safety against undermining they found that the railroad companies have adopted the concrete pile trestle bridge to quite an extent and they have studied this type with the idea of using it in highway bridges.

In this form of construction reinforced concrete piles are cast in forms on the ground and after the concrete has set for

about 30 days the piles are set up on end and driven with a large pile driver. The top of the pile projects above the ground and a concrete cap is cast, surrounding the top of the piles in each bent and forming a support for the superstructure.



NEW CELLULAR SLAB BRIDGE USED BY MINNESOTA HIGHWAY COMMISSION.

The most economical span between the bents for ordinary conditions in highway work is about 20 ft. and the new cellular slab superstructure described in this article is a very economical design to use for this substructure. No end abutments are used and the bridge consists of enough short spans to provide the proper water way after allowing the fill to run through the end piles on a 1 to 1 slope with riprap protection.

The bridge is very similar to the wood pile trestle bridges which have given such good service, except that concrete is used throughout, so that the rotting of the piles and joists and the wearing out of the plank floor is eliminated. In locations where it is not feasible to block up the channel with intermediate pile bents, the construction could consist of a long center span carried on a double row of concrete piles with a large concrete cap and with the approaches consisting of concrete pile trestles. Among the advantages of this type of substructure work, one of the most important is the fact that no excavation is necessary for foundations, thereby greatly reducing the cost of construction.

The available working season will practically be doubled in length of time as even a slight raise in water level prevents cofferdam excavation, while the piles can be driven at all stages of water level, except flood stages, which are generally of short duration. This will allow contractors to employ laborers at a time of the year when harvesting is not in progress and fewer laborers will be necessary as more equipment will be used instead.

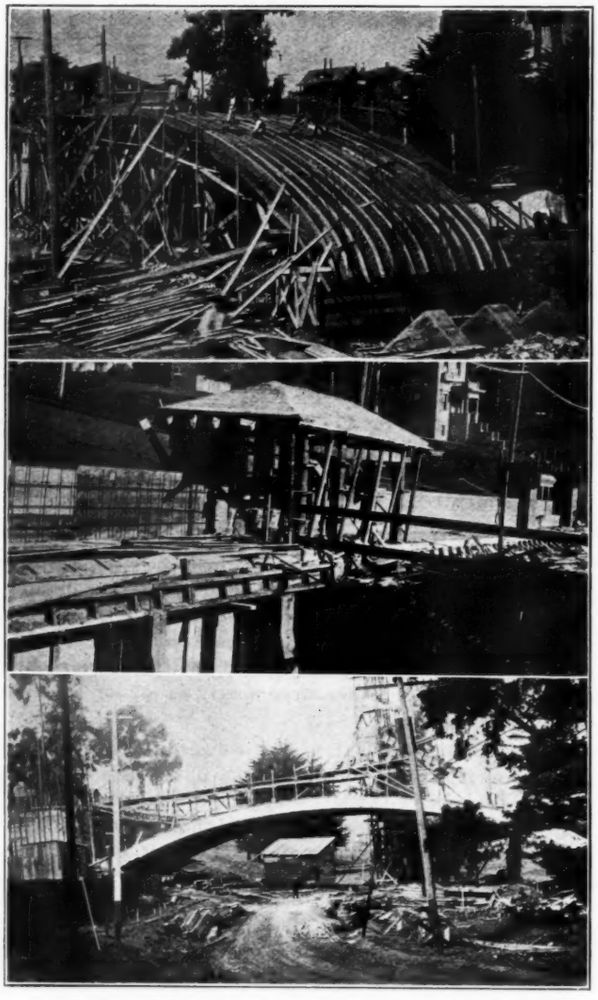
Bridges of this type can conveniently be increased in length, should more water have to be carried because of extensive new drainage work upstream from such a bridge, as there are no end abutments to be replaced by piers.

There have been many cases where old bridges have had to be rebuilt because the abutments have been undermined by a drainage ditch run under the bridge in which case the bed of the stream was artificially lowered but with the concrete pile bridge this would not cause any trouble.

These bridges are most economical where a large number are let under one contract because the cost of shipping the heavy equipment to the territory is distributed and each bridge is charged with only a fractional part of this expense, and this type is especially adapted to the construction of bridges under a bond issue and one county contemplated building 102 bridges this season and thereby eliminating the expensive maintenance costs on the old bridges, while they are paying for the new ones.

Design and Constructional Features of the Oakland Avenue Reinforced Concrete Bridge, Piedmont, Cal.

The design and constructional features of the new reinforced bridge on Oakland avenue, Piedmont, Cal., are here illustrated and described, with special reference to unusual details. One novel feature is the introduction of four covered resting places supported by light concrete columns and covered with Spanish tile.



CONSTRUCTION VIEWS OF OAKLAND AVE. REINFORCED CONCRETE BRIDGE, PIEDMONT, CALIF.

At the portals are four large pylons, capped with decorations cast in concrete and inclosing large ornamental electric lights. The total length of the structure is 362 ft. 10 in., including a central arch span of 130 ft., with symmetrical ap-

proaches composed of reinforced slabs supported by girders and columns inclosed in 6-in. exterior curtain walls. Each transvere bent is made up of three columns.

The roadway is 22 ft. wide, with an additional 6-ft. sidewalk on either side. The intrados curve of the arch was chosen for beauty as well as economy. The rib was analyzed by the elastic theory, and both temperature and rib shortening were provided for. The slab of the approaches and the arch were designed to carry an interurban electric car, and the sidewalks were designed for a live load of 150 lbs. per sq. ft., carried by ornamental brackets rigidly connected to the arch rib and approach slabs.

There was a timber trestle on the site containing about 40,000 ft. of lumber, and this was largely used for shoring and centering for the new bridge. The excavation in both abutment pits was made with teams, slips and plows. The soil was firm clay and occasional gravel, with but little moisture.

The stone used was a blue trap from a quarry near the site, and the concrete in the bases of the piers was laid for 60 cts. per cu. yd., $4 per day being paid to concrete men. It may be mentioned that the false work of the arch was made of 8x10-in., 8x12-in. and 10x12-in. stock. The bents were on approximately 5-ft. centers, and the posts of each bent on 6-ft. centers. The posts were placed normal to the intrados curve, and were supported on continuous sills firmly imbedded in the soil. The false work was unusually heavy and clumsy, but the timber from the trestle was old and its strength could only be guessed at. Heavy caps were placed transversely on each bent, the caps in turn supporting longitudinal stringers on 2-ft. centers.

There were placed on top of the stringers 2x4-in. pieces, blocked up and sprung to the curve. In some portions of the intrados curve where the curvature is great, 2x4-in. stock could not be sprung without splitting, and use was made of two pieces of 1x6-in., nailed together. It is said that these readily took the desired spring, and the variation from the true curve was practically nil when the decking was finally placed. Constant wetting down (sometimes four times daily) kept the decking in excellent condition. Points on the intrados curve, near the crown, were built ¼ in. higher than required to allow for settlement in the foundation of the false work.

The bridge was designed by John B. Leonard, of San Francisco, and the writer is indebted to Engineer W. P. Day, of San Francisco, for the photographs and data on this bridge. He states that the concrete of the rib was poured thru timber chutes leading from a hoist at the center. Doors in the chute were provided in case the concrete flowed too rapidly, and separated the coarser from the finer components, but their use was found unnecessary, the pitch of the chute being a minimum.

It is said that on the completion of the casting, and for several days thereafter, the arch was wet down four times daily. The usual buckling of the forms at the crown, after pouring the haunches, did not occur, owing to the inclination of the posts. The false work remained under the rib for about six weeks. The contractor deemed it proper to strike centers before the spandrel wall forms were set in place, so as to allow the arch to take its unconstrained shape, without subjecting the walls to the consequent stress.

The approaches are symmetrical, each being a 15-in. reinforced slab supported on transverse girders. The forms were made in the regulation way, and no difficulties were encountered. The entire lower approach was poured thru the chute, the length of the latter from the hoist over the mixer being 180 ft. The chute was 18 in. wide and 10 in. deep, and had a drop of 2½ in. per ft.

The mix being run a little wet, produced a perfect concrete at the extreme end. On account of the depth of the girders they were poured in two parts, 4x12-in. blocks, and ⅜-in. roads were used to provide for horizontal shear at the plane where the work was stopped. All of the side walls were poured to the bottom of the sidewalk, a dap of 1 in. being left for each bracket and anchor rods provided for each. The upper approach could not be poured by the chute without building a very high tower, on account of the grade of the bridge, and resort was made to the regulation buggies, hoisting first from the mixer to a runway over the arch.

Four expansion joints were used in the structure, each arranged so as to be hidden by the piers. The use of asphalt was originally contemplated, but was replaced by two thicknesses of heavy felt. Little or no dirt can penetrate the joint, and it is believed that a better working joint has been obtained than would have been produced by the asphalted joint, the material of which would expand and contract with variations in temperature. This bridge cost about $36,000, with electric lighting effects, and about 2,250 cu. yds. of concrete and 80 tons of steel were placed in it.

SALES ENGINEERING

Selling the Services of a Construction Company

By Leonard C. Wasson, President Aberthaw Construction Co., Boston, and W. P. Anderson, President, The Ferro Concrete Construction Co., Cincinnati.

The question is asked, What has a construction company to sell? According to the type of contract this may be a building, or it may be the services requisite to construction of a building, said Mr. Wasson in addressing the World's Salesmanship Congress. In order to grasp the selling problem it is necessary briefly to review present methods of letting contracts. The most common is the lump sum contract. This is used exclusively on public work by the federal and state governments, municipalities, and largely in private work. Bids for public work are publicly advertised for, and on private work it is often by invitation to a selected list. When this method of letting work is used there is no selling necessary or possible. The work is awarded to the lowest bidder unless it is clearly shown that he is unfit to be entrusted with the work, when the next man may do enough selling to prove he is fit, and that he is worth the difference in price between his bid and that of the lowest.

Going After Cost Plus Contracts.

What the contractor really does under the above method is to agree to build at his own expense a structure according to the plans and specifications provided by the buyer and to sell it for a lump sum arranged for in advance, when completed to the liking of the buyer and his engineer. The price does not necessarily indicate the real cost of construction plus a fair remuneration for the contractor's services. The purchaser agrees to buy on the installment plan by making partial pay-

ments. Contracts on some privately-owned work are let on cost plus fixed sum or percentage profit basis, and for these aggressive selling is needed. Some of the arguments which the salesman can use to persuade a buyer to accept these types of contracts are: The work can be started before the plans are made and six weeks' time can be saved. The contractor's and the owner's interests are mutual, therefore, better and cheaper results are obtained than with a lump sum contract where the parties' interests are antagonistic. Changes, either additions or deductions, can be easily made and at cost. The mutuality affects the design, purchasing of material, and sub-contracts, obtaining of labor and finance. Eliminates friction with the inspector.

Specific Suggestions.

The first step necessary is to seek out opportunities for obtaining these types of contracts. The most effective method is by visiting cities and towns seeking information from all available sources, including calling on the various parties who are thought to be considering the erection of new buildings. This method is slow and expensive. One man cannot cover much territory and do it well.

A less expensive way to cover a large field is by advertising literature. Volumes have already been written and more will be written on this important subject. It is a big problem. The construction company who is seeking day work or fixed sum profit contracts needs to reach directly the executive official in whose hands rest the final decision as to the awarding of a contract.

The writer's company has, after various experiments, decided on the plan of sending something once a month to its mailing list. This necessitates something bright, interesting, and brief, and, therefore, not very expensive in itself. If the advertising makes enough impression on the recipient to draw an inquiry, it has done its work. These are very desirable as they bring the salesman and buyer together on a very pleasant basis much increasing the former's effectiveness. Then the real selling campaign begins.

Methods of Approach.

No fixed rule can be laid down of methods to be followed. Assume he is a total stranger at the start. Write a letter for an appointment; send some information and perhaps literature to make him want one. Then get a letter of introduction from a mutual friend. This will get you past the office boy. The representative who calls must be very pleasing in personality, with ability to meet the prospect on his own footing, and to make a good impression. He should be able to answer almost any question asked him regarding the operating details of his own company intelligently and authoritatively. He must be perfectly frank and truthful, even if it results in losing an order. A favorable impression is left that some time will help the salesman's company. Many salesmen fall down by their failure to tell the truth when it hurts.

He must everlastingly present the main issues; the decision must be hammered through on principles.

It is desirable that he should know enough about other lines of work, so that he can, without being officious, offer advice wisely on matters concerning the business of the prospective client.

After making a man's acquaintance the steps which follow are easier to determine upon. They consist in part of getting his friends to write or see him in your behalf. He is affected most by successful competitors in his own line of business who write or see him and endorse your company. Induce him to write to ten or more of your own recent clients so as to get disinterested opinion from those who have had recent experience with you as to your worthiness. If they come from men respected in the business world they will frequently land the job.

Backing Up the Selling Force.

This leads again to the question, What has a construction company got to sell under the cost plus a fixed sum type of contract? Its service, that is, its ability to construct a given piece of work quickly, economically and safely to the complete satisfaction of the owner and his engineer, so that he will be satisfied or more than satisfied with the final result, and can be relied upon as a salesman to help you sell subsequent work on account of his enthusiastic endorsement of the service he has received. It is certain that a company doing this type of business must give better service than the ordinary run of contractors in order to make it worth the owner's while to employ the company to do its work rather than another contractor as the result of competitive bids. The construction company must, therefore, have a most efficient organization to back up its selling force. This includes an efficient engineering department, as frequently the designs of the structure have to be made, or if these are completed, there are designs of mechanical plant, general principles of the execution of the work, details of forms for reinforced concrete, details of windows, doors and miscellaneous iron work and minor parts of various sorts, also schedules of materials to be bought. The execution must be planned by competent superintendents; there must be a standing organization which can be put upon work promptly, which has been tried and found trustworthy, besides a good employment department for obtaining labor. Also estimating, purchasing, bookkeeping, auditing and cost accounting departments; and in these days of congested transportation, a traffic department.

It has been found desirable and almost necessary for the salesman to keep in touch with the owner and the contract from start to finish, in order to see that every detail of the agreement with the owner, both written and verbal, is lived up to; not only in letter but in the spirit, and, if possible, that results may be even better than those promised when the job was sold.

The salesman must be somewhat of a free lance, particularly in regard to his time, so that he can keep an appointment at the purchaser's convenience without fail. It requires a much different temperament, for a man whose time is largely devoted to selling and not fully occupied, from the man who executes the work, and must be always available to supervise details of construction, and who is largely absorbed in numerous details which do not give him time for reflection and decision on the larger problems which come before the salesman. Therefore, the two activities cannot be combined in one man.

Experience of the Ferro Concrete Construction Co.

The experience of the Ferro Concrete Construction Company of Cincinnati in selling its services were described by W. P. Anderson, president, as follows:

"From the experience of our company I feel that salesmanship plays an important part in obtaining work on a competitive basis. This scarcely applies to competitive work let by public bodies, but even they have some discressionary power, and it is advisable to have those who control the letting of such work familiar with the reputation of the bidder. In bidding on private competitive work, the owner is not bound by any rules and often favors a contractor on account of his reputation for fair dealing and excellent work.

Expense of Bidding.

"There are certain general points to be considered in the selling problem, regardless of the form of contract and other points must be considered with particular reference to the class of contract under which the salesman is endeavoring to get the work. The overhead expense of a construction company is a small percentage of its total business. It can be made lower on work done on a cost-plus-a-fixed-sum or percentage than for work done on a flat price, as in the latter case many more

careful and expensive estimates of cost are required in getting work. The money saved can be utilized in giving more to actual clients, by being liberal in settling disputed points, thus causing them to become repeaters and boosters, which is one of the greatest selling assets. The tendency, in competitive bidding, to estimate a great number of jobs is partially due to the fact that engineers and architects expect it. Sometimes the contractor guesses or obtains a figure from other contractors in order to put in a high bid to satisfy the architect. High bidding does not hurt the competitive bidder as it creates a feeling of superiority, and other things being equal, the superior firm gets the job, often at a higher price than his competitor. This may have a different effect on clients letting work on a cost plus a fixed sum or percentage basis, as here he is vitally interested in the contractor's ability to do good work at a minimum cost and maximum speed, with as little annoyance and friction as possible. Our salesmen emphasize these points as well as our firm's engineering ability, which often causes a great saving in original cost or in the operating cost when the structure is in use, and we bring these facts home by having former clients write or speak of them to prospective clients.

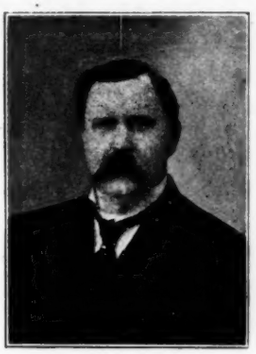
Salesmen Should Be Independent.

"There is a tendency for architects and owners rather to look down upon the contractor, hardly considering him their equal but as a slick fellow who will bear close watching. They consider it a favor on their part to allow the contractor to bid, not realizing the expense he is put to in so doing, and that they are the ones that need the favor and that, in reality, the shoe is on the other foot. The salesman should be independent and not tolerate this attitude, but consider himself absolutely on an equal plane. The class of men in control of the firms who are forging ahead in the field of getting work on a cost-plus-a-fixed-sum or percentage basis are of the highest type and the reputation for honesty and merit required for this class of work does not go with servility.

"Over 90 per cent of our present work was obtained on a cost-plus-a-fixed-sum or percentage basis, which is growing in popularity, due to the many advantages inherent in this form of contract. The Munitions Board, Council of National Defense, are thus letting contracts due to the speed obtained thereby. The salesman must overcome a prejudice against this form of contract as, at first, an owner cannot see the merits, often because he does not get work this way, not realizing the difficulty of checking costs in a factory, with large overhead expense and more than one client, is overcome where practically the entire work is done at one spot and for the client exclusively. The feeling that the contractor is a robber and holdup by going after work he is unfitted for, which was in evidence in General Goethals' position in the disagreement between him and Messrs. Eustis and Clark, must be overcome, but this feeling, in general, may be made an asset to the salesman where he can show that his firm does not possess these qualities and can convince the owner of the manifold advantages of the cost-plus-a-fixed-sum or percentage contract.

Salesmen You Ought to Know

He is known as The Road Machine Man and signs the hotel register as P. C. Elsey of Quincy, Ill. Take a look at the halftone and you will henceforth be able to pick P. C. up at the road shows and elsewhere. He is with the Baker Manufacturing Company of Springfield, Ill., and he travels the grand old State of Missouri, where, despite Reed and Stone, they have to be shown. He is doing missionary work among the contractors and county clerks on the famous Maney Four-Wheeled Scrapers and "Uncle Jim" Levelers, both of which are practically new in Missouri. Of course he also sells the rest of the line handled by his firm. He is now independent, as his kids have all grown up and are doing for themselves. He takes such long jumps that nothing shorter than the Missouri Pacific reaches all the places he makes. He frequently buys motor cars from the livery people who never forget that he has to go



P. C. ELSEY.

and they charge accordingly. The cars are retained by these livery sharps, however, so they can sell him again when he comes to town. He says the descendants of the James and Younger brothers are all in the livery business in Missouri. When he gets a bit of spare time he visits the Ozark country by way of relaxation. He gets his fun as he goes along—he says it is a picnic to sell Maneys.

This busy individual is not an editor, although his desk looks likes ours about three days removed from the dead line. This is Mr. Carleton Hill Jones of 1015 Newhouse Building,

CARLETON H. JONES.

Salt Lake City, Utah. He represents the Chain Belt Company of Milwaukee and the Diamond Rubber Company of Akron, Ohio. He covers Utah, Nevada, Idaho and Wyoming. Although a resident of Utah, he is not a Mormon—in fact he is not married at all. Like the machine that he sells, he is a batch mixer. His freedom from domestic worries is not entirely responsible for the gladsome, carefree expression he is wearing in the picture. The camera caught him in the act of signing an order to the Chain Belt Company for the second 14-S Concrete Mixer (Rex) just sold to the Lynch-Cannon Engineering Company of Salt Lake. Some people have all the luck.

FROM WORKERS IN FIELD AND OFFICE

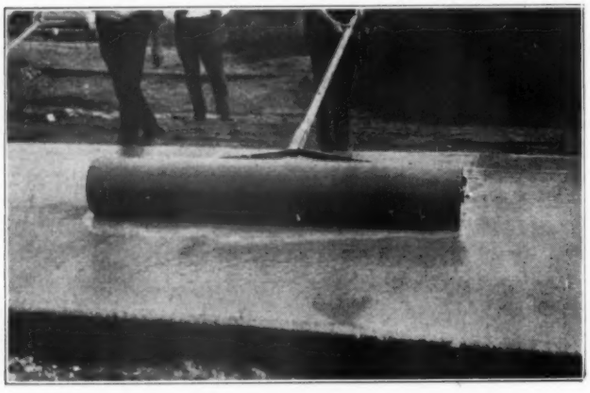
The Concrete Road Roller Successfully Employed on Vermilion County (Illinois) Roads

The Editor of MUNICIPAL ENGINEERING:

Sir—

Concrete roads are here and are likely to stay for a long time, and it behooves engineers to eliminate all preventable defects and to improve the character of the work, both the surface finish and the general character.

Engaged in building 144 miles of these roads, and having already completed 80 miles of them, and having them under



ROLLER USED ON CONCRETE ROADS, VERMILION COUNTY, ILLINOIS.

constant supervision during construction, I may be in a better position than most engineers to detect defects, and, having diagnosed the disease, to suggest a remedy.

Why Roller Is Used

The elimination of the excessive water which is necessary to use in mixing and placing concrete roads, and the compacting of the surface, have claimed the attention of all engaged in this class of construction, especially engineers. Henry W. Bowlby, former state engineer, State of Oregon, invented, patented and successfully used a roller of the contour of the road, operated by a gas engine running on the side forms. Capt. J. J. Gaillard, city engineer, Macon, Ga., uses a small hand roller of dimensions unknown to the writer. (Described in Plant Units and Layouts Section of this issue.—Editor.) City Engineer Johnston, of Sioux City, uses dry sand cement mortar worked in by hand floats, all of these for the purpose of removing excess water from the concrete and compacting the surface, and I had attempted it by persistent working with templates, floats, belts, etc.

Repeated laboratory tests made by the writer and others have proved beyond question that excess water weakens concrete, particularly in the early periods, in both tensile and compressive strength, in proportion to the excess of water used. There can be little doubt that excessive water leaves concrete porous and tends to produce excessive shrinkage in warm or windy weather. The matter was the frequent subject of discussion between Mr. F. Kaufman, of the Portland Cement Association, and the writer. Both sought a remedy, if possible an inexpensive one, that could be tried out on our county bond roads, contracts for which had been let and for which there were no further funds available. He agreed to furnish a roller if I would agree to find a job on which to experiment with it. The first roller, 9 in. in diameter, 4 ft. long, made of No. 18 galvanized iron, with heads of the same material, and weighing 46 lbs., was placed on Division 5 of our county bond roads. The contractor, Prendergast-Clark Construction Company, agreed to give it a trial. So impressed was Mr. Prendergast by the work done by this roller that he wouldn't be without one. This roller has been in use some two months and has surpassed our expectations, leading to our determination to further experiment with sizes and weights till an ideal roller is produced.

Four additional rollers have since been placed. The Granite City Lime and Cement Company have placed one on each of their Divisions 2 and 7, 12 in. in diameter, 4 ft. long, with wood heads, weighing 56 pounds. P. M. Johnston & Co., Division No. 8, one 10 in. in diameter, 5 ft. long, weighing 54 pounds, and John F. McMahon, Division No. 6, 12 in. in diameter, 5 ft. long, and weighing 66 pounds, the last four using No. 20 galvanized iron. It is difficult to determine which of these is the best. All show splendid results, but the roller 12 in. in diameter, 4 ft. long, seems to be most convenient. The larger sizes are clumsy and unwieldy. One man can readily handle the smaller size.

The immediate effect of the use of these rollers is a marked lessening of the water content, a forcing down of the coarse aggregate (particularly as applied to crushed stone), leaving a smooth, dense surface which is easy to finish. These rollers are popular with engineers, contractors and workmen. All seem to take a particular interest in seeing them work successfully, and they have prevented almost entirely hair checking and wind cracks in hot and windy weather. This latter effect alone would justify their use, as all familiar with this class of work can attest. The most valuable effect, however, is that it lessens the cost of finishing and makes a better finish than either the hand float or belt.

Use of Roller

The method used here is as follows: Immediately after the template is see-sawed across the forms, the roller, fitted with a 10-ft. handle (it may be longer for wider roads), is pushed slowly across the concrete and then is pulled back again over the same area. The roller is lifted forward the length of itself; the rolling is continued until the template is reached. A stream of water free of cement and aggregate flows in a wide stream ahead of it and over the side forms as the roller moves in each direction. After the roller is used the first time a long handle float is drawn across the pavement, smoothing the surface. Water rapidly collects on this surface. The use of the roller a second time disposes of this water by pushing it over the side as the roller moves back and forth. If a great excess of water happens to be used, rolling must be continued till the excess disappears. Concrete roads caught in the rain may be refinished readily by using the roller. After the second rolling the concrete is ready for final finish with long-handle float.

An accurate record of the stations on the various divisions where the rollers are in use is on file for future observation of the roads under traffic. A close-up view of the roller is here shown.

Very truly yours,

Danville, Ill. P. C. MCARDLE,

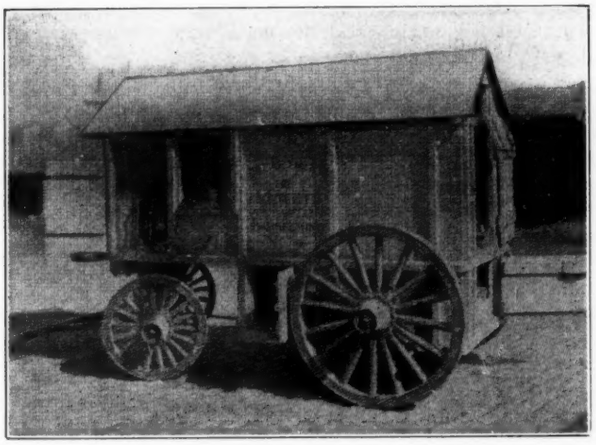
Superintending Engineer, Vermilion County.

Home-Made Street Roller Tender or Tool Wagon

The Editor of MUNICIPAL ENGINEERING:

Sir—

The steam roller tender or tool wagon here illustrated is made from the running gear and other parts of old garbage wagons, ash wagons, dump carts, buggies, etc., which have been junked. This is done at the shop, which is maintained by this department. As we utilize old material such as we have we do not have regular plans or specifications. These



A HOME-MADE STEAM ROLLER TENDER OR TOOL WAGON.

tenders have several compartments, in which are stored the various supplies required by the roller, such as coal, grease, and other tools used on the job, such as shovels, picks, etc.

Very truly yours,

F. H. CLARK,

Springfield, Mass. Supt. Streets and Engineering.

What Type of Engineers Should Go Into the Contracting Business?

The Editor of MUNICIPAL ENGINEERING:

Sir—

I do not think that any engineer should attempt contracting unless he has a liking for construction work, a passion for organization, equipment and men, and is more or less of a good loser. To elaborate this somewhat, all undertakings in which engineers and contractors are engaged consist of two parts, the design and the construction. While the two are merged more or less into each other, one may be a very competent designer and be a very poor constructor, and vice versa. In other words, a man may have a dream of how a thing should look when completed, yet may have only a vague idea of how the mechanical details for the carrying out of his dream should be arranged to carry his idea out economically. And here is where your passion for organization steps in. A good organizer never is satisfied until each detail is planned and carried out in the simplest, easiest and most efficient, consequently the most economical, manner. And there is probably the most important point in contracting to-day.

If, then, your candidate for contracting can go to letting after letting, spending his money, without getting anything, without getting stampeded, and bidding in a job where he is certain to lose; and if, after he gets it, he can sit down calmly and see the profits he supposed he had in his contract gradually disappear through causes over which he has no control and which he can't even fight, then let him tackle the game. If not, he had better stay out of it.

All of the above refers, of course, to the man that has to start in a small way, as most engineers would, I presume. If a man has means to engage in contracting on a large scale, I do not think he ought to risk his own money until after several years of experience with a good contracting firm doing the same class of construction work in which he himself expects to engage later.

Very truly yours,

Marion, Iowa. A. P. MUNSEN, Contractor.

(The foregoing letter from a trained and experienced engineer who has made good in the contracting game was contributed on special invitation. He "hopes he has made it plain that contracting is not all scittles and beer, but a mighty tough game at times."—EDITOR.)

Why Cities Should Continue Making Public Improvements Without Waiting to See How the War Turns Out

The Editor of MUNICIPAL ENGINEERING:

Sir—Humanity and civilization represented by the allied nations of the world will triumph over brutal barbarism as represented by Prussia, the Hohenzollerns and the Hapsburgs. Were this not so we might as well spend the money on public improvements as to leave it for confiscation by the Kaiser. A Prussian conquest is, I believe, now beyond attainment and we need only be concerned how best to support our country in this hour of great need and to carry on business as usual.

To carry on business as usual demands that construction work, in so far as is feasible, be continued.

If the need for a public improvement now exists then such need will continue to exist and the only factors we should consider are necessity and cost. It is to be taken for granted that when a public improvement is planned that it is a necessary improvement. There remains then but the question of cost to be considered and whether the cost will be greater if done now or later.

It is illogical to assume that lower costs will prevail on any great number of items of materials or labor, because both materials and men are being consumed in this world war and by consumed I mean that very little salvage of materials will occur and what is sad to believe is that many of our best men will be wiped out of existence also.

The remaining members of the human family will have to be cared for and an immense amount of rebuilding of all classes must necessarily follow the declaration of peace. A decrease in cost of steel and other metals may not be expected within two years after hostilities are suspended and other building materials to a great extent will also hold firm.

Construction work is one means of keeping money in circulation. Stop all labor and allied pay rolls and chaos would result. No community should rashly stop making necessary improvements if money is obtainable for financing the contracts.

A good part of the money required to finance our war expenditures will come from the wage earners if they are employed, but the same potential buyer of a liberty or similar bond will become a public charge if he cannot find employment.

The labor problem may tend to cause a cessation of work, but this is a question which will tend to solve itself despite the activities of Pro-German labor agitators. The activity of such agitators should be curbed and it may be found advisable to form state or federal commissions to inquire into and adjust on an equitable basis all complaints, reworking conditions, rates of pay, etc. It is very probable that this is a matter which could be handled by the federal government to the end that no strike would be allowed which would interfere with the prosecution of the war. The production of food, clothing, munitions, etc., and the handling, storage and transportation of same should come within the jurisdiction of such commissions

as regards the settlement of workmen's complaints and the prevention of strikes by employes engaged in such work. It may be asked what this has to do with the prosecution of public works, but if it is realized that federal commissions or some similar bodies can control in a fair manner all labor questions of a national import then there is no reason why every state in the Union should not have its own labor commission to handle all matters of local importance. Such commissions may exist in some states and if so they should have broad powers so that they can prevent either party to a labor dispute taking an undue or unfair advantage of the other. The honest and efficient administration of such commissions will tend to cause the employer and employe to arrive at a better understanding than now exists.

The above is but a general summary of some of the factors affecting public improvement works and it is to be hoped that all responsible persons will consider the probability that lower costs will not prevail for some years after the war and that in the meantime the necessary improvements will be adding to the health, comfort and safety of the people who, in the end, will have to pay the bills.

Yours very truly,

W. R. Harris.

Builders Exchange, Louiville, Ky.,
September 1, 1917.

Who Is to Blame?

The Editor of Municipal Engineering, Sir: Rarely does a road discussion take place that some one does not deliver a broad-side concerning the high-pitched earth road—the dirt road with side slopes so steep that a flivver travels cornerwise like a pug dog trotting, or, if the road is wet, everybody crawls along the crest like a small boy on the barn roof. And, almost invariably this broad-side is aimed at the road officials. But, are the officials alone to blame? Doubtless they are directly responsible but is it not barely possible that some of the rest of us should be handed some of the blame?

Tucked away some place in nearly all road books, bulletins, and speeches is a statement to the effect that "an earth road

A SECTION OF THE DIXIE HIGHWAY IN ILLINOIS. MISTREATED PERIODICALLY WITH A TRACTOR AND LEVELER. CROWN 2 1-5 IN. TO THE FOOT. UNCOMFORTABLE WHEN DRY—DANGEROUS WHEN WET.

should have a maximum crown of about one inch to the foot." And so it should, but what comes next? Why, these same books, bulletins, and speeches, aided and abetted by catalogs, salesmen, and machinery demonstrators unite with one mighty voice to say that the way to care for an earth road is to "begin at the sides and work towards the center carrying the dirt inward to build up the crown."

Good! Anybody can understand that. Anybody can get aboard a road machine and see that its nose is in the ground and that a goodly quantity of dirt is moving to the middle to build up the crown. Who remembers anything about that "inch to the foot" business? And if a wee small voice should call it to mind who cares for a little noise like that? The big racket is to "begin at the edge and work to the center to build up the crown." And anyway the chief function of an earth road is to furnish a place to run a big tractor and grader—the bigger the better—the safety and comfort of traffic is merely incidental.

The trouble is that a method has been emphasized to the detriment of the desired result. Whenever the public, the engineer, the road official, and the machinery man, get clearly into their heads that the shape of the road is the important item, whenever they learn to recognize a properly shaped road on sight and to know that it is immaterial whether the dirt moves inward, outward, or any other way, as long as the proper shape is being secured, then these disgraces to civilization will disappear and be replaced with well-kept, slightly crowned road-ways—comfortable and safe to travel and easy to maintain.

Very truly yours,

C. C. WILEY,
Instructor in Highway Engineering,
University of Illinois.

Urbana, September 13, 1917.

Mobile Equipment Drives Trench Sheeting Swiftly and Economically

The Editor of Municipal Engineering:

Sir—

Sewer construction on the New Jersey coast is always attended with great difficulty. Soil in many locations is pure white sand, often completely saturated to within 1 or 2 ft. of the surface with ground water. Under these conditions all

CONTRACTOR'S IMPROVED EQUIPMENT FOR DRIVING SHEET PILING.

excavation must be completely inclosed in very tight sheeting, not so much for the purpose of keeping the ground water out as to prevent the sand from shooting into the trench thru any openings which may exist. For the same reason it is most essential to drive the sheeting to within 1 to 2 ft. below the subgrade, depending upon the depth of the trench.

In excavating the trenches for a sewer system constructed under the above conditions it was found to be too slow and expensive to drive the sheeting by hand. As a result a special

rig was devised by the contractor from the equipment which he had on hand. This outfit is illustrated by the accompanying half-tone, and consisted of a light steam hammer swung from a derrick, mounted on a motor truck. Steam for operating the hammer was furnished by a small road roller, thus making the whole outfit easily mobile. In driving the sheeting a water jet was used to aid in rapid penetration.

With seven men an average day's work consisted in driving from 200 to 220 2-in.x8-in.x12-ft. sheet piling in a trench 10 ft. deep. The cost, including equipment charges, labor and water for jetting, was approximately 27 cts. per lin. ft. of trench.

The outfit was devised by H. W. Underwood, member of the firm of Field, Barker & Underwood, contractors, who was in personal charge of the work. The engineers were Remington & Vosbury, Camden, N. J. The writer was resident engineer on the job.

Very truly yours,

Camden, N. J. A. B. DEPUY.

Motor Trucks on Highway Work

The Editor of MUNICIPAL ENGINEERING:

Sir—

For power purposes on road construction in this locality motor trucks are sold. In highway maintenance and construction the work is so varied that power of this character is found to be very efficient. The truck is so constructed that it will pull heavy grading machinery and is also equipped to handle material to the best advantage. Power of this kind has two great uses in road construction; one is for handling road-grading and building machinery for dirt roads and the other is for handling materials for building and constructing special surfaced highways, and in this work we have found the motor truck a very successful machine and it covers this field well.

Very truly yours,

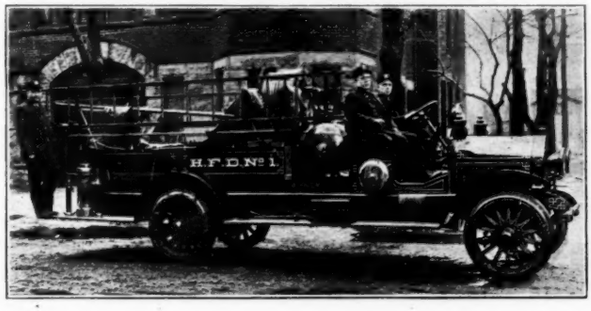
Topeka, Kans. H. S. PUTNEY.

FIRE ENGINEERING

Fire Department of Harvey, Ill., Motorizes

The city of Harvey, Ill., recently installed a two-ton Harvey motor-driven combination chemical and hose truck. The machine is equipped with all of the latest and most approved starting equipment and is here illustrated.

The city of Harvey, which has a population of about 12,000, is under the commission form of government and municipal



HARVEY, ILL., COMBINATION CHEMICAL AND HOSE TRUCK.

progress has lately been rapid. The extension of the fire limits to 1½ miles more in each direction from the fire station made plain the need of more adequate protection than hitherto has been afforded by the old horse-drawn equipment.

The question of cheaper maintenance was also a determining factor that influenced Fire Chief A. Bouk and the city commissioners in making the change to motor apparatus. For ten years past the local fire department has made runs averaging 50 miles annually, and horse maintenance with feed, shoeing and incidentals in the interim was unduly heavy. Hence, the city of Harvey regards its new motor apparatus as an actual economy as well as an aid to better fire protection.

Trucks to Displace Tacoma's Horses

According to a plan recently submitted by Commissioner Pettit, of Tacoma, Wash., the horses and horse-drawn fire apparatus of that city are to be superseded by up-to-date automobile fire trucks. Quoting from a local statement:

"The Tacoma fire department is already partly supplied with motor vehicles, and there can be no question of their efficiency. It is said that part of the department now having horse-drawn vehicles has a maintenance cost of $64,154 a year. It is computed that the cost of maintenance when motorized would be 50,071 a year, which would mean a saving of about $14,000 a year in maintenance. In five years such a saving would pay back the $60,000 it is proposed to borrow for the new equipment, and interest besides. The fire department will shortly have to expend about $25,000 for horses and horse-drawn equipment unless it adopts the motorizing plan. The seven motor vehicles it is proposed to buy would, according to estimates, cost $60,000, or about $35,000 more than new horses and horse-drawn apparatus. From one point of view $35,000 is all the city would need to save by reduced cost of maintenance to prove the motor plan a public economy. Another item to be considered is the $5,000 or more the city would receive by the sale of horses and horse-drawn vehicles."

Using Dynamite to Check Fires

Many fires have been checked by the use of dynamite, notably the Atlanta fire. At Atlanta 2,000 homes had burned down when a liberal use of dynamite finally gained control of the fire. One of the expert explosive men who helped check this fire discussed wrong and correct methods as follows:

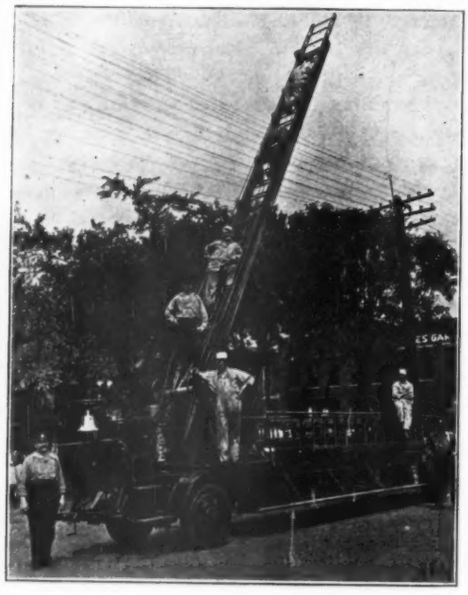
"Up to our arrival there had been burned about 50 city blocks and after we started the fire did not get out of four city blocks, three of which were dynamited by us.

"When we arrived I found the dynamite squad were attempting to dynamite the houses by tying three or four sticks of dynamite together and priming and throwing them at random into a house, the result of which was to merely shake the house and blow out the windows so that it caught fire more readily.

"I took from one to three cases of 50 per cent Red Cross extra to a house, depending on its size and solidity, and placed it as near to the center of the house as possible, on the ground floor and against the strongest wall. This brought the house down level with the ground in every case and in such shape would enable the fire company to get a stream on it at once. We shot two houses at once and used cap and fuse method."

Decatur, Ill., Has New Motor-driven Aerial Truck

C. W. Devore, fire marshal of the city of Decatur, Ill., not long ago strengthened his fire fighting equipment by the purchase of a Couple-Gear motor-driven aerial truck. The ladder, weight 850 lbs., can be either raised or lowered by one man. In a recent full hour's test of the ladder and hoist, the ladder sustained an aggregate weight of 760 lbs., the firemen being distributed at various heights as shown in the accompanying photograph. There was no apparent deflection or drop even under this unusual strain.



DECATUR, ILL., MOTOR DRIVEN AERIAL TRUCK.

Chief Devore reports that the machine works very smoothly and is easy to operate after little practice. "It has plenty of power and speed," he says, "and the hoist is far ahead of any similar one of which I know. Certainly if we were in the market for an aerial truck, we could do no better than duplicate the machine we already have."

Progress of Motorization of Wisconsin Fire Departments

Wisconsin cities are rapidly motorizing their fire equipment. Even small cities are replacing horse-drawn apparatus with more efficient and more economically maintained modern motor equipment. The apparatus being purchased varies widely in make, combination and price. In order to be able to furnish cities contemplating the purchase of new equipment with information concerning the installations that have been made in other cities of similar size, the municipal reference bureau recently collected data along these lines and they are reported by Ford H. MacGregor, chief.

There are 39 cities in the state in which the fire departments have been fully or partially motorized.

All cities of over 5,000 population in the state, with the exception of six—Beaver Dam, Marshfield, Marinette, Oconto, Portage and South Milwaukee—have installed motor fire apparatus. The following cities of less than 5,000 population are supplied with motor equipment: Berlin, Columbus, Cudahy, Delavan, Evansville, Hudson, Lake Mills, Platteville, River Falls, Stoughton, West Bend and Whitewater.

Cities Planning Purchase.

A number of Wisconsin cities are planning to purchase motor apparatus for their fire departments in the near future. Among cities planning the immediate purchase of motor fire apparatus are: Black River Falls, Clintonville, Fort Atkinson, Horicon, Jefferson, Marinette, Monroe, Portage, Richland Center, Stanley, Tomahawk, Viroqua, Wauwatosa.

Make of Apparatus Used.

A list follows which shows the make of each machine, and how many of each are in use in Wisconsin fire departments: Ahrens-Fox, 1; American-La France, 20; Buick, 2; Carter Car, 6; Chalmers, 1; F. W. D., 1; Ford, chassis locally equipped, 5; Harder, 1; Jeffery, 8; Kissel, 3; Menomonie, 1; Mercedes, 1; Mitchell, 5; Oakland, 1; Overland, 1; Owens, 1; Palmer-Singer, 1; Seagrave, 23; Service, 1; Smith, 1; South Bend, 1; Stegeman, 3; Sterling, 1; Studebaker, equipment made by Peter Pirsch, 1; Thomas, 1; Victor, 1; White, 4; Wisconsin, 1.

As indicated by this list some cities have not bought the standard motor fire apparatus, but have had their apparatus made to order by regular automobile and motor truck manufacturers. In some cases the chassis has been purchased and the equipment made by local contractors or built by the fire department.

DIGEST OF THE ESSENTIAL NEWS

Massachusetts Takes the Hazard Out of Road Contracts

The State Highway Commission of Massachusetts is carrying on some of the road work under its charge by new forms of contracts, designed to shift to the state the burden of extensive charges for labor and materials and the responsibility for delivering materials when needed. Under existing conditions no contractor can afford to bid on extensive road work except at a price high enough to save him from loss in case labor and materials increase greatly in price. Under ordinary conditions an experienced contractor can foresee changes in such prices and allow for them, but he cannot do so at present, and consequently his bids on work are very high. It is not believed that these high prices on materials and labor will continue, and the new form of contract used in Massachusetts will enable the state to save considerable money when both labor and materials can be procured at a lower figure than the contractor now believes it safe to figure on.

First Form of Contract

Last May the state made a contract with an experienced highway contractor under which it agreed to furnish all the machinery and materials and the contractor agreed to furnish all labor, teams and small tools. The books of the contractor are kept in detail and are open to the examination of the State Highway Commission at all times. The commission pays the contractor for his labor expenditures every week or every fortnight, and it also pays for workmen's insurance. Maximum limits have been set for the pay of labor, but these can be increased by mutual agreement should necessity for doing so arise. The other expenditures of the contractor are paid back

to him monthly by the Highway Commission. The contractor receives for his overhead expenses, personal services, the use of small tools and for his profit an agreed-upon sum for each unit of work performed, these prices being made out on the basis of so many cents per cubic yard for gravel surfacing, so many cents per ton for local broken stone in place and rolled, so many cents per foot for pipe, and the like.

Second Form of Contract

Another form of contract that is used has been adopted when all bids for a job were considered too high. In such a case an arrangement has been made with the low bidder to do the work at actual cost, plus an amount for profit and overhead expenses figured on the unit of each class of work, as 7½ cents per cubic yard for excavation. Under this contract the contractor supplies labor, tools and machinery and pays his liability insurance, while the Highway Commission furnishes the materials and pays the contractor his actual expenses. If the actual cost of the work proves less than the original bid, the contractor shares the saving equally with the Highway Commission, but the contractor in no case is to receive more than his bid. Under this form of contract the state is assured that the work will not cost more than a specified sum, and if the expense of construction is less than the contractor estimated, the state will obtain the road at a lower price than the original bid.

Savannah Builders Pool Interests

The contractors, building supply men, electrical men and builders in general of Savannah are preparing to pool their interests, their labor, finances and other assets, to enable them to compete with other cities of the Southeast, where similar actions are said to have been taken, and with the wealthy Northern firms in bidding on big contracts. A number of big government contracts are in sight that Savannah firms, as individual corporations, are not able to secure. An organization to be known as the Savannah Builders Exchange is to be formed. The contractors have decided that the need of the organization is urgent.

Old Mexico Is Going In for Heavy Construction

The Mexican government has committed itself to the policy of constructing at the earliest possible time a system of modern highways that shall connect all the principal cities and ports of that country. This movement was inaugurated several weeks ago by the department of communications and public works, following the outlining of the tentative plan for construction and improvement of the highways of the country. A meeting of good roads enthusiasts from different parts of the country was held in the City of Mexico and the organization of the National Highway Association of Mexico resulted.

It also is proposed to build a modern highway to run from the City of Mexico to Vera Cruz, following the ancient highway that was built by Cortez about 400 years ago. There are still remnants of other ancient highways which were built in the days of the Conquistadores, and wherever it is possible these old camino reals, or main highways, will be rehabilitated and put to modern use. The import during the last two months of more than 5,000 motor cars is serving as a stimulus for a good roads movement.

American Association of Engineers Organizes Three New Chapters

The Board of Directors of the American Association of Engineers, at their meeting on September fifth, granted charters to the members in St. Paul, Indianapolis and Milwaukee. This makes a total of seven chapters which have been organized since the Association was incorporated about two years ago. The total enrollment of the National Organization is over twenty-two hundred different members.

A joint meeting of the association and the Detroit Engineering Society was held in the Commerce Building, Thursday, August thirtieth. It was the unanimous opinion of the engineers present that the Detroit Society should form a working co-operation with the American Association, as they have been carrying out a similar program locally for Detroit as the other organization has operated in a national way. The Detroit Society has a total enrollment of about seven hundred members and if this working co-operation is established it will mean the furthering of the work laid out by the committee on Engineering Co-operation.

Membership in the American Association of Engineers is being extended to all technical engineers in military service without payment of initiation fee or dues. This is part of the co-operative plan to keep them advised as to progress in the engineering field and to give them personal assistance upon their return to their professional work.

Federal Government Apportions $14,550,000 to Help States Build Good Roads

The Secretary of Agriculture has announced the apportionment of $14,550,000 of Federal funds to be used in the fiscal year ending June 30, 1919, by the several states in the construction and maintenance of rural post roads, as follows:

State	Sum Apportioned	State	Sum Apportioned
Alabama	$ 313,456.47	Oregon	236,332.74
Arizona	205,540.58	Pennsylvania	690,145.78
Arkansas	250,018.47	Idaho	$ 182,471.55
California	456,167.23	Illinois	658,323.48
Colorado	257,278.92	Indiana	406,230.18
Connecticut	92,216.45	Iowa	434,653.61
Delaware	24,411.99	Kansas	429,131.88
Florida	170,723.88	Kentucky	292,984.62
Georgia	403,909.45	Louisiana	203,755.29
Massachusetts	221,261.85	Maine	144,807.42
Michigan	435,356.37	Maryland	130,871.43
Minnesota	425,865.40	Rhode Island	34,972.38
Mississippi	268,751.60	South Carolina	215,014.08
Missouri	508,603.98	South Dakota	243,175.61
Montana	299,520.89	Tennessee	340,663.51
Nebraska	319,445.25	Texas	876,986.70
Nevada	193,229.82	Utah	170,763.17
New Hampshire	62,610.11	Vermont	68,128.92
New Jersey	177,357.22	Virginia	298,120.77
New Mexico	238,634.55	Washington	216,530.19
New York	749,674.20	West Virginia	159,713.89
North Carolina	342,556.47	Wisconsin	382,707.20
North Dakota	229,585.91	Wyoming	183,805.78
Ohio	558,043.42		
Oklahoma	340,489.34	Total	$14,550,000.00

This is the third apportionment under the act, $4,850,000 having been apportioned for the fiscal year ending June 30, 1917, and $9,700,000 for the fiscal year ending June 30, 1918.

Are the Railways Opposed to Waterways Development?

Many who would have favored waterway construction programs but for the feeling that strong railway lobbies would throttle all such projects at birth, should note the following extracts from a recent letter by the vice-president of the C. B. & Q. R. R. to the frieght departmeent of that prominent road:

"There is every indication that for some time to come the traffic offered for transportation in this country will be in excess of the capacity of the rail facilities which are available. I want to reiterate to you, and through you to our representatives generally, that it is the earnest desire of the management that every opportunity be taken to assist in the development of the practical use of the waterways.

"Some of the steamship people, shippers and the public

generally have in the past been inclined to the view that the railroads would by all means in their power discourage the use of water facilities by making low competitive rates and through refusal to participate in joint rates and though billing arrangements, declining to build tracks to docks, etc., and we want, if possible, to have this view changed as quickly as possible."

1917 a Great Building Year

Comparative statistics of building and engineering operations in Illinois, Indiana, Iowa, Wisconsin, Michigan and portions of Missouri and eastern Kansas, as compiled by the F. W. Dodge Company:

Contracts awarded January 1 to July 1, 1917	$344,419,000
Contracts awarded January 1 to July 1, 1916	219,237,086
Contracts awarded January 1 to July 1, 1915	119,020,600
Contracts awarded January 1 to July 1, 1914	104,656,000
Contracts awarded January 1 to July 1, 1913	106,531,000
Contracts awarded January 1 to July 1, 1912	59,402,000
Contracts awarded January 1 to July 1, 1911	80,822,313
Contracts awarded January 1 to July 1, 1910	111,958,798

Other sections of the country also made good showings. The 1918 record will probably be even better than that made in 1917.

Four Lines of Anti-Submarine Investigation

The stage at which the naval consulting board has arrived in its grapple with the problem of the submarine is outlined in the first bulletin on "The Submarine and Kindred Problems," issued recently by the board. The pamphlet is primarily intended to serve as an aid and guide to citizens who are responding to the board's request for suggestions on how the U-boat menace may be met. Thousands of such suggestions, it is stated, have been received since the board made its appeal.

The latest type of submarine in use abroad, the pamphlet states, "has a surface speed of at least seventeen knots an hour and a submerged speed of probably less than ten knots. If running near the surface the periscope might be raised, a quick observation taken, and lowered again, within thirty seconds. If, however, the submarine is on the surface and hatches uncovered, from one to four minutes will be required to completely submerge, depending upon circumstances."

Four lines of investigation to combat this instrument of destruction have been followed by the Naval Consulting Board. They are: 1. Means of discovering the approach of a hostile submarine and locating it so as to permit of prompt action for combating its attack. 2. Protection of cargo carrying ships by nets, guards and screens. 3. Protection through decreasing the visibility of vessels. 4. Methods of destroying or blinding a hostile submarine.

Meanwhile, What of the Alaska Railroad?

The government railroad in Alaska will hasten the development of that territory's vast resources; will encourage the production of foodstuffs, thus reducing the territory's dependence upon the United States for supplies; will furnish coal in unlimited quantity for the navy, obviating the necessity for the transcontinental shipment to the Pacific of fuel for government vessels, and at the same time release thousands of cars for the transportation of war materials and foodstuffs.

Purposes of Road

On March 12, 1914, the Alaskan railroad act was approved by the President. This act authorized and directed the President to locate a railroad in the Territory of Alaska not to exceed in the aggregate 1,000 miles. The purposes of the road, as set forth in that act, were as follows:

1. To connect one or more of the open Pacific Ocean harbors on the southern coast of Alaska with the navigable waters in the interior.

2. To connect with the coal fields so as best to aid in the development of the agricultural and mineral or other resources.

3. To provide transportation of coal for the army and navy, transportation of troops, munitions of war, the mails, and for other governmental and public uses, including the transportation of passengers and freight.

The primary purpose of the railroad system authorized in the act was to develop the mineral resources of Alaska, particularly its coal.

Parts Under Construction

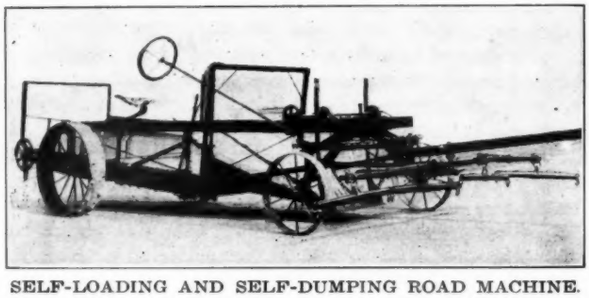
The main line of the road is now under construction from Seward, on the Pacific coast, inland for 470 miles to Fairbanks, on the Tanana river, a large and navigable tributary of the Yukon. There is now in operation 150 miles.

PLANT UNITS AND LAY OUTS

A Self-Loading and Self-Dumping Machine

The loading device on the Spaulding self-loading and self-dumping machine, here illustrated, is a part of the body. That is, it is attached to the front end of the body, and the body is pivoted on the rear axle a little back of its center. The cutter or blade is attached to the main frame of the body, is convexed and polished like a plow share, and extends back to the steel guard, which extends a little over the lower front end of the endless elevator apron, which elevates the dirt into the front end of the body. In the bottom of the body is the main endless apron, which carries the material to the rear of the body as fast as the front end is filled. The front end of the body, to which the blade is attached, is raised and lowered by a worm gear, which is under the control of the operator, and can be held to any depth desired. Both the elevator apron and the main apron are under the control of the operator, and either may be run independent of the other.

In loading the machine it is simply necessary to throw the



SELF-LOADING AND SELF-DUMPING ROAD MACHINE.

elevator in gear and lower the front end of the body until the cutting edge is the desired depth, then as the front end of the body is filled the main apron is thrown into gear as desired, until the load is completed. The front is then raised and the load is ready to be delivered. The load may be dumped in one place by a foot lever or spread while the machine is advancing 45 ft., by throwing the main apron into gear. The machine need not be stopped for any operation excepting when dumping in one place by means of the foot lever.

These machines have been tried out for over a year and have made good, it is said. They will work in sod or hard road without first plowing. They have taken up dirt out of the middle of a road that had 2 in. of frost in it. It is claimed the machine will load from 1½ to 2 cu. yds. of dirt in 20 seconds and will unload it just as quickly, either scattering it evenly over 40 ft. of roadway, or the machine can be backed up to a hole or low spot and the dirt all dumped in one pile.

Design and Use of Asphalt Pressure Distributor Wagons

Extensive use of Stanolind paving asphalt has been made in the past three years in sheet asphalt, asphaltic concrete and especially in asphalt macadam pavements and roads.

To aid in the proper construction of asphalt macadam roads, the Standard Oil Company of Indiana have built and equipped a number of asphalt pressure distributer wagons; these wagons hold about 650 gal. of asphalt and have a large fire box, and are equipped with a Westinghouse air compressor for maintaining pressure on the tank to about 40 lbs. They are used for applying the asphalt to the courses of stone on the road. It has developed from actual experience that roads constructed in this manner have proven successful and far superior to those made by the old method of applying by hand with pouring cans.

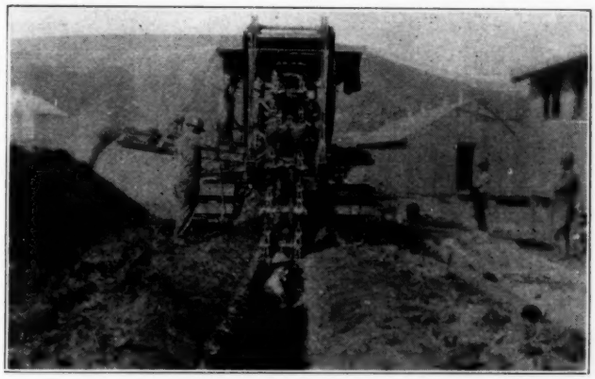
The company have specially equipped tank cars in their service for the shipping and handling of the asphalt, and the asphalt is unloaded from the tank car into the pressure distributers with the equipment contained on the wagon, which makes a very simple arrangement throughout.

The method of constructing roads with an asphalt macadam wearing surface 2½ ins. has been systematized so that the builder can start from the beginning of the road and go out over the road and return over the completed road with an empty tank wagon. This enables him to keep his work completed up to the close of each day, with the exception of possibly 100 ft. or so. In fact the road can be opened up to travel as fast as the work proceeds in putting on the 2½-in. wearing surface. One tank wagon on an average haul of one mile from the tank car to the work will complete an average of 1300 to 1600 sq. yds. of pavement a day, it is claimed. The rental for the wagons is nominal.

Ditcher Makes Good Run on Cantonment Job

Many miles of water and sewer pipe lines were constructed in quick time at each of the new cantonments for the National Army. A Pawling and Harnischfeger ditcher is here illustrated at work at the Fort Riley, Kans., cantonment. It was operated by Koehler & Thompson, excavating contractors of Kansas City, Mo., who were working for the Fuller Construction Company, the general contractors.

On this work the trenching machine made a run of 1,300 ft. in 10 hours in a 5-ft. cut, and made several other runs nearly as good as this. The half-tone shows the machine digging a water main trench 5 ft. deep in the camp of the Thirteenth, Twentieth and Twenty-first Cavalry. It wasn't busy all the time, as the pipe-laying forces couldn't keep up with it.



VIEW OF DITCHER CUTTING 1,300 FEET OF 5-FOOT TRENCH IN TEN HOURS.

STANDARD METHOD OF APPLYING ASPHALT MACADAM BY PENETRATION METHOD WITH PRESSURE DISTRIBUTOR WAGONS.

Turbine Traction Grader Makes Good Record on Chicago Streets

The Koehring turbine traction grader owned by the American Asphalt Construction Company, of Chicago, is here shown in operation on a Chicago street. This machine, recently perfected, has made a fine record on work in Chicago. This type of machine was first tested out thoroughly by the R. F. Conway Company, of Chicago, and many improvements in it were suggested by the Conway Company. They co-operated with the Koehring Machine Company in perfecting the grader. High officials of the Conway Company and of the American Asphalt Construction Company are enthusiastic over the machine in its present stage of development.

The editor is indebted to Mr. Royer, president of the American Asphalt Construction Company, for the specific data on the output of this machine here given. On July 9 of this year the performance of the grader was closely observed. That day was selected as a representative day. The machine was working in clay on the Laflin street system on the South Side

VIEW OF NEW TURBINE TRACTION GRADER.

of Chicago. A total of 624 cu. yds. of clay were handled and hauled ⅜ to ½ mile to the dump, in 1¾-yd. loads. Wagons were loaded in from 50 to 70 seconds. The working day was of nine hours. Here are the cost figures:

Item	Unit Cost	Total
17 teams at	$7.00	$119.00
1 foreman		6.00
1 operator		7.00
1 helper		3.50
2 laborers at	$3.00	6.00
Gasoline and oil		12.50
Total cost		$154.00

Total cost per cubic yard, 24.7 cents.

The foregoing record was made when the machine was being driven by a 32 to 34-h.p. engine, which was found too light. When a higher power engine was installed a deeper cut could be taken, and this reduced the time of loading from an average of 60 seconds to 45 seconds.

The best day's run was 610 wagon loads containing about 1½ cu. yds. each, and the cost of excavating and loading was around 4 cts. per cu. yd.

Portable Heating Furnace for Bituminous Pavement Tools

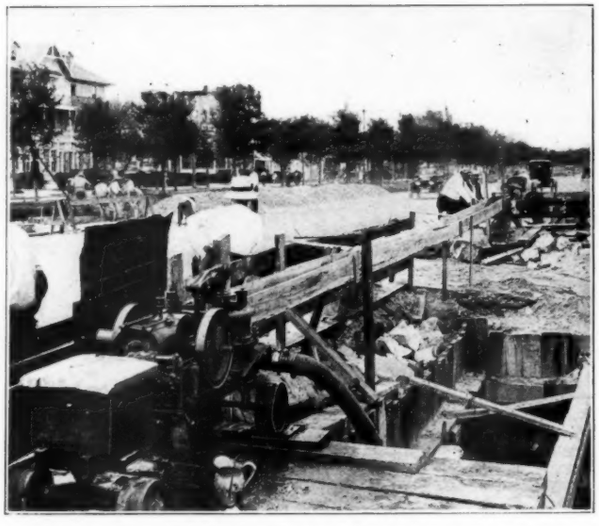
The new portable heating furnace here illustrated, of Chausse manufacture, is designed to heat tools used on bituminous pavement work. It has a battery of three burners, and produces a very hot, clean flame. It does away with the annoyance of smoke from the burning of wood and also the carting of wood and ashes. Tools can be kept hot all the time. The receptacles at the top are for buckets for the joint

NEW HEATING FURNACE FOR BITUMINOUS PAVEMENT TOOLS.

cement and the shovel. This unit is very useful in connection with asphalt paving work. Clarence A. Proctor, asphalt expert, of the Detroit Department of Public Works, has used these heating furnaces for a couple of months and considers them satisfactory. The fact that the heater is designed for the burning of oil not only makes it clean, but keeps the expense of operation low. It is so constructed that it can be transported by hitching it to an auto truck.

Using Battery of Diaphragm Pumps to Pump Tidewater

On the Coney Island Terminal job tidewater was encountered at a depth of 4 ft. in the excavation on this $3,000,000 job. Salt water flowed freely through the sandy bottom into the foundation pits. This heavy infiltration went on, of course, day and night. The Lord Construction Company put eight Atlantic diaphragm pumps on the work of keeping these



USING ATLANTIC PUMPING ENGINES ON CONEY ISLAND TERMINAL EXCAVATION.

pits unwatered until the concrete footings could be completed. The 4-in. Atlantics handled as high as 8,000 gals. per hour. They kept the pits dry until the latter were sealed with concrete and the footing complete around the pile heads. They

required little attention, as one man could look after three or four.

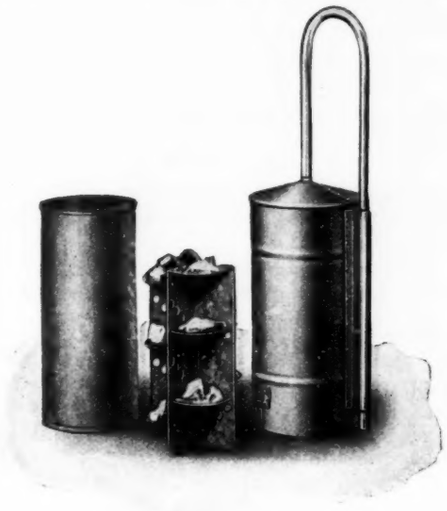
These Atlantic pumps have jump-spark ignition and are sure fire. They have easily accessible parts and are readily handled by unskilled labor. The engine and pump are mounted on a stout, easily portable steel truck, as shown in the view.

An Improved Portable Acetylene Light

A new portable acetylene light, which presents several important improvements, has just been placed on the market.

The carbide holder of this Milburn light contains twelve perforated pockets, shaped like inverted cones, arranged around a vertical axis, like a spiral stairway. This construction eliminates the possibility of overcharging and permits the use of any size carbide—a feature of economical significance.

Again, owing to this arrangement, the lights are automatic, whether burning continuously or intermittently. The moment the light is turned out the water is driven out of the carbide



NEW PORTABLE ACETYLENE LIGHT.

chamber and gas generation ceases; after generation is impossible. They require far less attention, it is claimed, than the ordinary lights; there is less waste of carbide and more even pressure, resulting in more sustained and steadier action at no increased cost; they are practically self-cleaning.

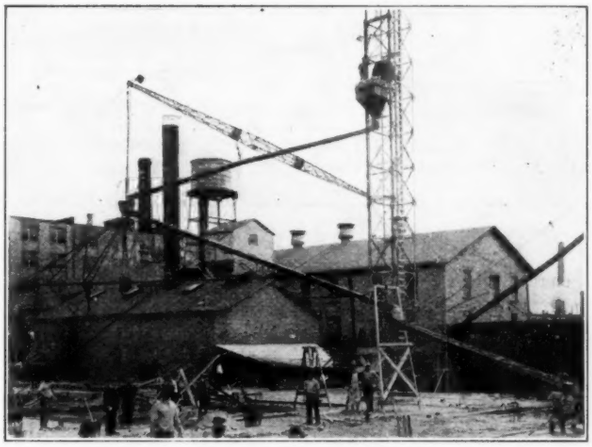
In recent government tests these lights showed a strength of 5,000 candle power for more than 12 hours on 8 lbs. of carbide—a cost of less than 3c per hour. The United States government has standardized them for the navy yards and over one-third of the government cantonments were constructed with the aid of these lights.

A Steel Tower, Open Boom, Counterweight Chute, Quick Shift, Gravity Concrete Distributing Plant

The essential time and labor-saving features of the Insley concrete distributing equipment here illustrated are emphasized in its self-defining name. While the price of steel is sky high, more of these steel hoist towers are being sold now than ever before.

It is claimed that the steel tower can be erected and dismantled in less than half the time required for a wooden hoist tower. The rigidity of alignment of the steel tower results in increased operating efficiency of entire plant. A western contractor who on one job used a steel tower and a wooden tower side by side with identical Insley equipment in each tower said that the steel tower plant showed a superior operating efficiency of about 25 per cent. It is claimed that the wood tower is good for three jobs at the outside while the steel tower lasts indefinitely.

A combination of a 50-ft. steel boom and a counterweight chute of equal length makes it possible to place concrete anywhere within a 100-ft. radius with a plant which is entirely self-supported from the tower. Many of the original users of chuting equipment have abandoned chutes in favor of buggies, owing to the trouble that was experienced in shifting the chute lines from one position to another. It is to obviate this



IMPROVED GRAVITY CONCRETE DISTRIBUTING EQUIPMENT.

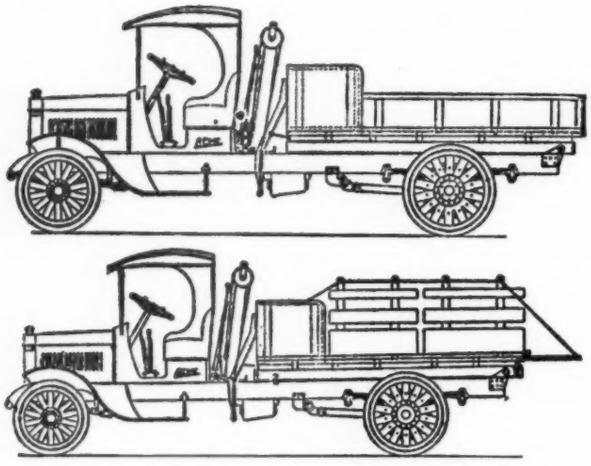
trouble that the steel boom-counterweight chute combination has been designed. If concrete is to be transported more than 100 ft. it becomes necessary to support the end of the counterweight chute with a tripod, this tripod is so low, however, that it can easily be moved.

It is claimed that the Insley quick shift feature is one of the greatest time saving devices that has ever been placed at the contractor's disposal. It consists of a steel frame which slides on the front legs of the tower, this frame carrying the tower hopper and boom supports and being moved by a manila rope shift line which runs off from the nigger-head of the hoisting engine. Whereas with the old style equipment the hopper and boom supports were bolted direct to the face of the tower, thus requiring the best part of half a day to make a change in the vertical point from which concrete was spouted, with this new quick shift equipment a change can be made within 15 minutes' time. It is therefore a case of having the concrete gang idle for 15 minutes when the pouring shifts from one elevation to another, instead of one-half a day.

A Special Combination Dump and Stake Truck Body

The special combination dump and stake motor truck here illustrated was designed to combine the advantages of the Acme all-steel dump body with those of the Acme standard stake body.

The dump body sides are constructed in the form of a substantial wooden frame lined with steel, reinforced with angles securely riveted to the steel plates. The tail gate is 15 ins. high of all-steel construction. The battlements, 24 ins. high and 30 ins. long, of one piece rolled steel plate reinforced with steel angles and four wooden stakes, unite with the dump sides in forming an inside body compartment that will dump absolutely clean. A load can be dumped in 20 seconds. The battlements, which remain stationary, are built extra strong to withstand the strains which come from lifting of load for dumping purposes. The tail gate which swings from the top is operated from the driver's seat and can be opened full width or to any angle desired. This feature makes it well adapted



CONVERTIBLE DUMP AND STAKE TRUCK BODY.

for road building purposes, as the load may be distributed evenly. When not in use as dump body, the sides are instantly removable and four side stake gates, 36 in. high, which are furnished as regular equipment, may be substituted in their place. A 24-in. wood reinforced tail gate, when lowered, extends platform length to a practical 12-ft. body for all kinds of hauling.

This body is equipped with an excellent dumping arrangement for road work whereby the truck will dump the load in a pile, or by use of a special catch on the tail gate operated from the driver's seat which allows it to open only a few inches, it will dump while the truck is in motion so that the rock is spread evenly over the surface, saving a great deal of labor in hand spreading. The general utility of this body for road work and other kinds of hauling is obvious. It will give splendid service in road building and at the same time is instantly available for all the various hauling problems which come up in contracting work where a standard stake body is desirable.

In the illustration the upper view shows a 3½ tonner with sides in place ready for use as a dump body. Lower view shows dump sides removed, stake gates and 24-in. tail gate in place ready for use as standard stake job.

ADVANCE INFORMATION ON BIG JOBS

Connecticut Legislature Appropriates $6,500,000 for Road Construction

Manufacturing establishments in many Connecticut cities, notably Bridgeport, Waterbury, New Haven and Hartford, have been forced by the congested condition of the railways to employ motor trucks in making shipments within the state. This heavy traffic has developed so rapidly that the legislature has appropriated $6,500,000 for road work during the next two years, of which about $1,000,000 will be used for certain bridge and grade crossing work and the remainder will be spent at the discretion of the highway commissioner, Charles J. Bennett. He recently stated that the building of concrete, asphaltic concrete and other long-lived types of pavements will be continued. In a town near Hartford he is constructing a mile sheet asphalt on a 5-in. concrete base, because the intensity of the motor car traffic demanded a durable city street pavement and the availability of a Hartford contractor's experience and construction plant made this type the most suitable and economical.

Essential Elements in the Great Illinois Road Building Program

The greatest road building program in any state of the Union at the present is that in Illinois. It not only calls for building about 4,000 miles of hard surfaced roads, but it provides for the construction of this great mileage without any taxes on real estate. The project was worked out so as not to interfere with road building by the counties and townships and to enable the state to utilize in the most economical manner the financial aid and technical assistance which the federal government will give to Illinois under the federal aid road law of 1916.

A Real State Project

The improvement of these 4,000 miles will result in the betterment by the state of barely 4 per cent of its highways. Consequently the planning of these roads, so as to be of unquestionable benefit to the entire state and therefore a justifiable object upon which to spend state money, received long, careful study. It was necessary to afford the greatest good to the greatest number of people, to give careful attention to the cost of competitive routes and to distribute the expenditure over the state in such a way that no section could claim with fairness that it was treated inequitably. The network of state roads passes through every county in the state and connects all of the leading towns. It is not merely a matter of a few north and south roads intersected by a few east and west roads; it was laid out to meet the traffic needs of the state rather than to conform with the points of the compass.

Raising the Money

The most interesting feature of the project is the method of raising the money for the work. It is proposed to issue bonds which will be paid off from the proceeds of automobile taxation exclusively. Prolonged study of the use of improved roads has convinced the state officials that such a state-wide system of highways will be used so extensively by automobiles and trucks that the cost of the improvements should be borne by the owners of such vehicles. At present the license fee for cars ranges from $3 for 10 horse power or less to $10 for 50 horse power. Next year the taxes will be increased so that the limits will be $4.50 to $20, and in 1920 they will be increased to $6 and $25. The present motorcycle fee of $2 will be increased to $3 in 1918 and $4 in 1920. The fee for electric vehicles up to 20 tons capacity is now $5. This will be increased to $10 next year and $12 in 1920. Electric vehicles of over 2 tons pay double these fees, except in 1920 when the license will be $25.

It is proposed to begin issuing bonds in 1920, putting out $10,000,000 in that year, and to make a similar issue annually until the total bonded indebtedness is $60,000,000. It is proposed to let the first contract in 1920. In that year it is estimated that the license fees will amount to $4,800,000. The state officials estimate that in 1944 the fees will amount to $6,000,000, and both principal and interest will have been paid.

The interest rate which is proposed for the bonds is 3½ per cent.

Vote in November

Next November the electors of the state will vote on this project. It is unique in many respects, not only financially but also from an engineering point of view. Heretofore there has been pronounced opposition in some states to placing the cost of the construction of roads on motor owners exclusively. The opposition is not so strong now as it was. The automobile owner has learned, provided he keeps a detailed expense account for his machine, that improved roads not only enable him to get more service from his car or truck but also reduce materially the cost of operating and maintaining it. Any owner of a motor car can rest assured that the increased license fees proposed in Illinois, which will not be at all high at their maximum limit in 1920, will not only give all the advantages of better roads to travel over, but will also save money in the cost per mile of running his car.

Projects Embraced in the Program for Expanding Seattle Municipal Water System

The various projects embraced in the program for the expansion of the Seattle municipal water system and the contemplated order of their development are described authoritatively by Joseph Jacobs as follows:

1. Swan Lake Project

This contemplates the conversion of Swan Lake, which lies about midway between the present intake at Landsburg and the south city limits, intoo a storage reservoir at about 4,200,000,000 gals. capacity. In the event of an accident to the pipe lines above the reservoir it would afford an undiminished water supply to the city, at its present population and present rate of consumption, for a period of 100 days and for a longer period if emergency imposed the necessity of restricted usage. The plans provide for the construction of two small dams which will permit a 20-ft. rise of water above present lake level and the construction of outlet works consisting of an intake tower at the lake, a concrete lined outlet tunnel two miles long and of 150,000,000 gals. per day capacity, and a controlling tower at the lower end of this tunnel. The estimated cost of this development is $950,000 for construction and $300,000 for rights of way, or a total of $1,250,000. *The right of way purchases have practically been consumated and it is anticipated that bids for some features of the construction work will be called for within 90 days.*

2. No. 3 Pipe Line Project

This contemplates the construction of a pipe line of 50,000,000 gals. per day capacity extending along the route of the existing pipe lines from the lower end of the Swan Lake outlet tunnel, a distance of six miles to the south city boundary, where a controlling tower for all the pipe lines will be built, thence a distance of ten miles to Volunteer Park. It will be recalled that our No. 1 pipe line is now practically renewed and that our No. 2 pipe line is in such condition as to make preparation for its renewal within a few years imperative. This new pipe line will permit the No. 2 pipe line to be retired or renewed without embarrassment to a continuous full delivery of water to consumers. The estimated cost of this improvement is tentatively placed at $2,000,000, the present unstable prices of materials of construction making close estimating impossible as it also makes difficult a selection of the most desirable pipe material to be used.

3. Volunteer Park Project

This contemplates the enlargement of Volunteer Park reservoir from a single basin of 23,000,000 gals. capacity to a double basin of 60,000,000 gals. capacity, the extension being to the north of the existing basin. The location of this reservoir in the very center of the city makes it one of the most important units in our water supply protective system and it is therefore important that it be of large capacity. The present reservoir is unquestionably too small. The estimated cost of this improvement is $350,000.

4. West Seattle Project

This contemplates the construction of a pipe line of 50,000,000 gals. per day capacity extending from the proposed controlling tower at the south city boundary a distance of five miles to a commanding site in West Seattle, where a two-basin reservoir of an aggregate capacity of 220,000,000 gals. is to be constructed. This development will not only meet all future requirements of West Seattle, but will also protect our downtown district and will guarantee a safe water supply for the rapidly expanding industrial district south of Elliott Bay. The cost of this development has not yet been carefully estimated, but it may be placed roughly at $1,800,000. The necessary rights of way are now being secured.

5. Headworks Project.

This contemplates, though not for several years, the construction of a new dam and headworks at Landsburg. No definite plans nor cost estimates have yet been prepared for this project.

With the additional storage which these projects provide Seattle will have, within its immediate boundaries and extending along the north and south crest line of the city, a series of reservoirs whose aggregate capacity will be 523,000,000 gals. We have already indicated the beneficent function of Swan Lake with respect to the possible failure of the aqueduct above that reservoir and in like manner, in the contingency of disaster to the pipe lines between Swan Lake and the city, these well distributed interior reservoirs would afford a safe water supply for a city of half a million people for a period of two weeks.

There can be no doubt that these proposed developments are all desirable and that they must sooner or later be carried out if we would keep abreast of our requirements. The full consummation of the program will entail a cost aggregating approximately $5,500,000 and the only legitimate query concerning it at this time relates, not to the general merit of the scheme, but to the speed of its prosecution and to its bearing on taxes and city finance. The present plan is to issue utility bonds for these improvements, the first and immediate issue to be in the sum of $3,500,000. It is hoped that these expenditures will not necessitate an increase in water rates, but if such increase does become necessary its initial form will probably be toward equalizing the present disparity in rates charged the manufacturer and those charged the small home consumer.

The immediate undertaking of some of the elements of the general plan, as for instance the new pipe line, cannot well be deferred.

How to Drive Concrete Piles

The report of the American Railway Engineering Association on concrete piles includes a specification for driving that contains the following requirements: Piles shall be driven with a cushion cap; piles shall preferably be driven with a steam hammer; when a drop hammer is permitted it must be heavy, with a small drop; on sloping ground a hole shall be dug for the location of each pile; piles driven out of plumb more than ½ in. per foot must be pulled and redriven, if required; for working loads of 15 tons piles must be driven to a penetration of 2 in. in the last five blows with a No. 1 Vulcan steam hammer; for loads of 25 tons they must be driven to a penetration of 2 in. in the last eight blows with the same hammer; piles must not be handled on skids or moved to site before they are 28 days old.

Lights and Shades

The Lumber Jack on Railroad Construction

A. B. Carson, of The American Lumberman, sends us this French Canuck poem. Thanks, A. B.

My name is Joe le Flambeau.
I come from Canadaw.
I swing de canthook on de log
From Sault to Saginaw.
You bet your life de lumberjack
Dey all stan' roun' an' look
When Joe le Flambeau mounts de log
An' swings dat ol' canthook.

I work t'ree year for Bunyan—
Paul Bunyan, dat's de guy.
We work all winter on one pine,
De trees dey is so high.
Ten t'ousand men we had in camp,
So sure as you are born.
It took ten of de bigges' mans
To blow de dinner horn.

An' when de tam for lunch come roun'
Each man look at de moon.
De chore boy carry lunch dat year
In a grat beeg gas balloon.
An' when de mans come in at night
I tell you it was great.
To wait on all dose man in tam
De cook wear roller skate.

One winter when I work for Paul
De snow she was so deep
We cut de tree down from de top
An' haul heem up wit' sweep.
We sleep all Sunday in de camp
An' den work day an' night,
An' when we come to skid de log
We use a great beeg kite.

Den Paul shes go to Louisan',
An' me, I go wit' heem.
To clear a road across de swamp
We use five t'ousand team.
De alligat' she was so teek
Paul scratch hees head an' cry,
"We build a railroad an' we use
De alligat' for tie."

We capture all de alligat'
An' spike down all de rails.
De heads dey's lookin' all one way
An' all one way de tails.
But when we put de heads one way
We mak' one beeg mistak'.
We get hup in de mornin'
An' de railroad's in de lak'.

Seeing Things

Two laborers of color were tapping the trench bottom with their picks. Said one: "Tom, why don't you leave this place and travel? I've worked my way from New York to Frisco and from Chicago to New Orleans and I've seen the country. Why don't you travel and see the world?" A look of toleration came over the face of Tom. Said he: "Bill, has yo' ever had de D. T's.?" "No," said Bill. "Well, den," said Tom, "yo' ain't never seen nothin'—nothin' a tall."—J. B. K., New Orleans, La.

American Engineers Welcome in Berlin (?)

According to a recent number of the Proceedings of the American Society of Civil Engineers, among the societies to which members of the American Society will be welcome is the Architekten-Verein zu Berlin, Wilhelmstraase 92, Berlin, Germany. A similar welcome is said to be awaiting American engineers by the Sachsischer Ingenieur und Architekten-Verein of Dresden. Well, we shall soon see!

Forcing a Favorable Decision

A certain sales engineer travels in the South and is as energetic in all things as in selling. Some time ago he met a girl, as he frequently did, and proposed to her just three hours later. He didn't make the sale, but his follow-up was a hummer. When he reached her town he 'phoned his arrival. (He had previously ordered flowers sent to her house.) Then an invitation to dinner, the theater, then a late lunch, after which he always renewed his offer of marriage. This went on for nearly three years, and she hadn't accepted him. He grew desperate. He planned a knockout. The familiar program was followed, but on a more luxurious scale than ever before. After the late lunch they started to take a cab to her home, as usual, and eleven cabmen, all experienced on similar trips, applied for the job of driving them out. He hired them all and the procession started. Let him tell the rest of the story:

"As we swung into the street the procession formed. She saw it, and began expostulating, 'All those cabs can't drive out to my home. What will the neighbors think? Why, every one will think we are coming home drunk or crazy. What do you mean by it, Jack?'

"I just laid my hand on hers and said: 'Just a minute, Honey. There's a good reason for it. I've known you for over three years now, and I've always given you the best of everything. I've sent you enough flowers to fill a greenhouse. I sent you tons of candy. Maybe some of it was stale, but it was meant to be good and had a good brand on it. I've taken you to the best shows and bought the best seats the scalpers could give me. I've bought you enough dinners to keep a family for a year, and I've tried to sell you a life interest in a man I think is all wool and a yard wide, but you can't see it. Everything I have ever done for you has been done the very best way I know how. But after to-night you're dead as far as I am concerned, and I'm giving you the best funeral I know how. I've got every available carriage in town.'

"She looked dumfounded for a second—her face was a study. Then she began to laugh. She grabbed my hand with both hers and said, 'Jack, you're such a good loser I want you. Tell the rest of those carriages to go back and we will go out and tell the folks.'"

HOW THE CONTRACTORS ARE BIDDING

Bridge Bids Received on Contracts Awarded in August by Illinois Highway Department

Table I herewith gives data on bridges for which contracts were let during the month of August upon plans prepared for the Division of Highways of the Department of Public Works and Buildings of the State of Illinois. This tabulation is complete so far as the results of bridge lettings had been reported to the Division of Highways on August 31 by the county superintendents of highways.

In a letter to the editor relative to the work and the tabulation, Clifford Older, Bridge Engineer, said:

"The location, size and quantities are given for each bridge;

TABLE I—BIDS RECEIVED ON ILLINOIS HIGHWAY BRIDGES DURING AUGUST, 1917.

Name of Bridge	Township	County	Span Ft.	Roadway Ft.	Height Overall Ft.	Concrete Cu. Yds.	Reinforcing Steel Lbs.	Estimated Cost $	Bids Received $
Foehner	Burgess	Bond	6	20	Box Culvert	18.0	1,390	285)	
McHugh	Tomako	Bond	9	18	Box	29.9	2,170	475)	1.215
Mills	Tomako	Bond	8	20	Box	29.3	1,650	445)	
Cemetery	Locust	Christian	10	24	Box	44.5	4,180	800)	(2,109
McCluskey	Locust	Christian	12	24	Box	82.6	6,480	1,380)	(2,175
									(2,432
Bolivia	Mt. Auburn	Christian	One abutment only		23	80.8	6,290	1,650	(1,830
									(1,900
									(1,528
Cox	Pana	Christian	18	16	11	49.6	4,610	1,010)	(1,635
Goffinett	Pana	Christian	4	24	Box	9.8	975	200)	(1,783
Stock	Pana	Christian	8	24	Box	19.2	2,460	430)	(1,543
									(1,488
Kinderdine Ford	Melrose	Clark	2@40	16	17	290.8	23,130	5,170	(5,099
									(5,170
Duffey	State Aid Route 7	Effingham	2@50	16	34	686.1	71,890	14,500	14.500
			Steel I beams			in abutments			(2,350
Emerick	Bear Grove	Fayette	30	16	13	80.2	3,710	2,390	(2,194
									(2,140
									(2,249
									(605
Peters	Laclede	Fayette	14	20	8	33.8	3,580	680	(620
									(640
Holman	Lone Grove	Fayette	20	16	9'-8"	49.2	5,060	1,030	(975
									(990
Warren	Lone Grove	Fayette	10	20	Box	33.0	2,830	650	(595
									(620
Anderson	Ramsey	Fayette	Abutments only		11'-3"	38.3	1,900	700)	(1,957
Jones Corner	Ramsey	Fayette	14	16	12½	55.1	4,080	1,110)	(1,965
Williams	Crouch	Hamilton	Abutments only		10	25.6	1,310	530	500
Snicker	Dahlgren	Hamilton	Abutments only		13	41.9	2,330	790	(738
									(785
									(1,591
Brummer	Piasa	Jersey	35	16	13	86.1	11,630	1,830	(1,675
									(1,796
Grafton	Quarry	Jersey	5	24	Box	23.2	1.280	330	(406
									(476
No. 18	Richwood	Jersey	5	24	Box	21.4	2,890	450	(442
									(550
			Steel I beams			in abutments			
Crews	Allison	Lawrence	40	20	17	95.2	4,490	4,830	4,626
									(1,180
Antioc	South Palmyra	Macoupin	Abutments only		12	59.8	0	1,160	(1,158
									(1.020
Frampton	Alma	Marion	16	16	9½	43.6	3,880	880	830
Jacobs	Alma	Marion	10	18	Box	47.5	3,200	815	800
Coffin	Alma	Marion	20	20	11½	59.5	6,620	1,185	1,120
									(1,560
Arnold	Foster	Marion	26	20	11	69.0	9,610	1,700	(1,620
									(1,700
Thomas	Iuka	Marion	10	18	Box	41.8	2,930	745	711
Kitzmiller	Brookville	Ogle	10	24	Box	33.6	3,020	610	549
Meyers	Littleton	Schuyler	45	18	15	140.7	19,440	3,190)	(5,150
Newell	Littleton	Schuyler	8	20	Box	52.5	4,430	1.020)	(
Little Flock	Littleton	Schuyler	12	16	13'-9"	58.6	3,840	1,080)	(5,274
			Steel truss						(14,600
									(14,700
Van Scyoc Ford	Kansas	Woodford	125	16	25	202.5	8,950	13,750	(13,213
									(13,999
									(13,085
Ball	Hutsonville	Crawford	55	16	21½	228.2	27,530	4,540	4,747
Lindley	Hutsonville	Crawford	50	16	23	234.4	26,420	4,610	5,000

also the estimated cost as prepared by this department, and a list of the bids received.

"For small bridges we are not having any difficulty in letting contracts at prices which are generally very close to the estimated cost.

"During the past few months we have found that there is not very much competition among contractors for the large jobs. This is undoubtedly due, in a large measure, to the unsettled labor conditions. The conditions governing the cost of the bridges given in this tabulation, such as cost of materials, length of haul, nature and depth of excavation, etc., cover so wide a range that it is impossible to give all of this information in a tabulation of this kind."

Information to Bidders.

The Highway Department maintains a list of contractors who want to bid on Illinois highway bridges and mimeographed notices are sent to this list relative to each bridge letting. The notice contains information relative to the time and place of receiving bids, etc. A specimen notice, that relating to the Cox, Goffinett and Stock Bridges mentioned in Table I is here given:

STATE OF ILLINOIS
Department of Public Works and Buildings
DIVISION OF HIGHWAYS

PROPOSED BRIDGE CONSTRUCTION

Note:—The following information is believed to be correct and is furnished for the convenience of bidders who wish to make mailed bidds, but the Division of Highways assumes no responsibility for, nor guarantees as correct, any of the statements made herein.

ADVERTISEMENT.
HIGHWAY NOTICE—PUBLIC LETTING OF CONTRACT.

Notice is hereby given that sealed bids will be received for the following described bridge work at the time and place indicated below.

More detailed information may be had by an examination of the plans and specifications prepared by the Division of Highways, which may be seen at the office of the county superintendent of highways, or may be obtained upon application in writing from Clifford Older, bridge engineer, Division of Highways, Springfield, Ill.

Bids will be received up to 10:00 o'clock a. m., August 24, 1917, at the Town Hall in Pana, Ill., for the construction of three reinforced concrete bridges to be built in Pana township, Christian county. C. A. Penington, Co. Supt. of Highways, Taylorville, Ill.

Cox, Goffinett and Stock Bridges: Spans 18, 4 and 8 feet; roadways 16, 24 and 24 feet; height over all 11, 5½ and 7 feet. Estimated total concrete 49.6, 9.8 and 19.2 cubic yards; reinforcing steel 4610, 975 and 2460 pounds.

Nearest railroad station, Pana, 3¾ and 4 miles, and Millersville, 1 mile.

Materials for concreting must be shipped in.

All three bridges to be located on a new road. No present structures.

At site of Cox bridge, low water flow 2 inches deep, 10 feet wide; high water 6½ feet deep.

Average depth of excavation at Cox Bridge about 10 feet in clay to extend about 4 feet below stream bed. Excavation in clay at sites of Goffinett and Stock bridges to extend about 3 feet below stream bed for head-walls.

Work to be completed on or before November 15, 1917.

Engineer's estimate for three bridges $1,640.00.

Springfield, Ill., August 14, 1917.

The Low Bids Received by Ohio State Highway Department on Sept. 7 at $1,338,516 Letting Covering 66.86 Miles New State Aid Roads

The estimated cost of the 66.86 miles of new state aid road work on which bids were asked by the Ohio State Highway Department on September 7 was $1,338,516.68. The names of the low bidders, the amount of their bids and a brief description of the work bid on are here given. On some of the jobs scheduled no bids were received and others were cancelled—these are omitted from this article. The editor is indebted for this information to Clinton Cowen, State Highway Commissioner. The figures in parentheses following "bridges and culverts" is the engineer's estimate on this item.

Road 1—Adams Co. on Sec. B of the West Union-Hillsboro Road, in Wayne Twp. For grading, paving with water-bound macadam and constructing bridges and culverts. ($1,938.) Width of pavement, 14 ft. Roadway, 24 ft. Length, 5,580 ft., or 1.06 miles. Estimated cost, $9,211.50. Date set for completion, Dec. 15, 1917. Low bidder, Thomas Dalton, Winchester, Ohio; $9,211.50.

Road 2—Adams Co. on Sec. C-2 of the West Union-Sinking Spring Road, in Meigs Twp. For grading, paving with water-bound macadam and constructing culverts. ($807.) Width of pavement, 14 ft. Roadway, 24 ft. Length, 7,000 ft. or 1.33 miles. Est. cost, $8,500.24. Date completion, Dec. 15, 1917. Low bidder, J. M. Day & Co., Peebles, Ohio; $8,500.22.

Road 4—Butler Co. on Sec. I of the Hamilton-Middletown Road, in Lemon Twp. For constructing bridges and culverts ($3,275), grading roadway and paving with one of the following types:

Monolithic Brick $75,964.15
Reinforced Concrete 67,934.75

Width: Pavement, 16 ft. Roadway, 26 ft. Length, 16,803 ft., or 3.18 miles. Date completion, Aug. 1, 1918. Low bidders: P. J. Connell, Cambridge City, Ind., monolithic brick, $76,964.15; Strodbeck Brothers, Middletown, Ohio, reinforced concrete, $67,984.75.

Road 5—Butler Co. on Sec. J of the Hamilton-Middletown Road, in Lemon Twp. For constructing bridges and culverts ($3,390), grading roadway and paving with one of the following types:

Monolithic Brick $81,874.95
Reinforced Concrete 71,624.85

Width: Pavement, 16 ft. Roadway, 26 ft. Length, 18,700 ft., or 3.54 miles. Date completion, Aug. 1, 1918. Low bidder on monolithic brick, P. J. Connell, Cambridge City, Ind., $81,874.95. No bid on reinforced concrete.

Road 8—Delaware Co. on Sec. A of the Delaware-Prospect Road, in Delaware Twp. For constructing bridges and culverts ($3,842), grading roadway and paving with one of the following types:

Reinforced concrete: Width: Pavement, 16 ft. Roadway, 26 ft. Length, 12,000 ft., or 2.27 miles. Est. cost $60,121.91
Bituminous concrete: Width: Pavement 16 ft. Roadway, 26 ft. Length, 12,000 ft., or 2.27 miles. Est. cost 63,847.61
Bituminous macadam: Width: Pavement, 16 ft. Roadway, 26 ft. Length, 12,000 ft., or 2.27 miles. Est. cost 41,530.01

Date completion, July 1, 1918.

Low bidders: The Delaware Blue Limestone Contracting Co., Delaware, Ohio, reinforced concrete, $56,702.71. Federal Asphalt Paving Co., Hamilton, O., bituminous concrete, $63,700.

Road 9—Green Co. on Sec. I of the Wilmington-Xenia Road, in Caesar Creek Twp. For constructing bridges and culverts ($6,515), grading roadway and paving with waterbound macadam. Width of pavement, 14 ft. Roadway, 26 ft. Length,

26,659 ft., or 5.05 miles. Est. cost of construction, $56,652.79. Date completion, July 1, 1918. Low bidder, The Wilson Engineering and Contracting Co., Xenia, O., $55,587.

Road 11—Hancock Co. on Sec. A-1 of the Ottawa-Findlay Road, in Liberty Twp. For grading roadway, constructing bridges and culverts ($2,393) and paving with one of the following types:

Reinforced Concrete: Width of pavement, 16 ft. Roadway, 26 ft. Length, 6,758 ft., or 1.28 miles. Est. cost $27,304.92

Brick: Width of pavement, 16 ft. Roadway, 26 ft. Length, 6,758 ft., or 1.28 miles. Est. cost..... 37,417.33

Asphalt Concrete: Width of pavement, 16 ft. Roadway, 26 ft. Length, 6,758 ft., or 1.28 miles. Est. cost 31,718.67

Date completion, July 1, 1918. Low bidder, C. G. Withan, Deshler, O., brick, $36,500. No bids on concrete.

Road 13—Highland Co. on Sec. H of the Allenburg-Lynchburg Road, in Dodson Twp. For grading, paving with waterbound macadam and constructing culverts ($1,083). Width of pavement, 12 ft. Roadway, 24 ft. Length, 7,562 ft., or 1.43 miles. Est. cost, $11,743.83. Date completion, Dec. 15, 1917. Low bidder, C. A. Lunsford, Hillsboro, O., $11,643.

Road 20—Mahoning Co. on Sec. R-1 of the Akron-Youngstown Road, in Jackson Twp. For grading roadway, constructing bridges and culverts and paving with waterbound macadam. Width of pavement, 16 ft. Roadway, 26 ft. Length, 5,167 ft., or .98 mile. Est. cost, $12,146.60. Date completion, Dec. 15, 1917. Low bidder, L. H. Young Contracting Co., West Austintown, O., $12,054.74.

Road 21—Mahoning Co. on Sec. P of the Akron-Youngstown Road, in Austintown Twp. For grading roadway and paving with brick. Width of Pavement, 16 ft. Roadway, 26 ft. Length, 5,893 ft., or 1.11 miles. Est. cost, $26,120.85. Date completion, Dec. 15, 1917. Low bidder, L. H. Young Contracting Co., West Austintown, O., $25,483.23.

Road 23—Mercer Co. on Sec. E-1 of the Ft. Recovery-Minister Road, in Marion Twp. For grading the roadway, constructing bridges and culverts ($1,304) and paving with concrete. Width of pavement, 16 ft. Roadway, 26 ft. Length, 6,418 ft., or 1.22 miles. Est. cost, $31,210.03. Date completion, 75 per cent. Nov. 1, 1917, 100 per cent. June 15, 1918. Low bidder, Burnett & Christian, Rockford, O., $30,069.03.

Road 24—Monroe Co. on Sec. N of the Ohio River Road, in Ohio Twp. For grading and constructing drainage structures ($6,045). Roadway, 26 ft. Length, 4,988 ft., or 0.95 mile. Est. cost, $15,166.38. Date completion, July 1, 1918. Low bidder, V. Mange, Niles, O., $12,100.72.

Road 25—Muskingum Co. on Sec. L of the Zanesville-Cincinnati Road, in Newton Twp. For grading, constructing drainage constructions ($793) and paving with bituminous bound macadam. Width of pavement, 16 ft. Roadway, 26 ft. Length, 4,280 ft., or 0.82 miles. Est. cost, $15,183.48. Date completion, June 15, 1918. Low bidder, The J. A. Sevingle Constructing Co., Zanesville, O., $15,182.

Road 26—Pickaway Co. on Sec. L-1 of the Lancaster-Circleville Northern Road, in Walnut Twp. For grading roadway, constructing bridges and culverts ($1,357) and paving with waterbound macadam. Width of pavement, 16 ft. Roadway, 26 ft. Length, 7,250 ft., or 1.37 miles. Est. cost, $24,109.27. Date completion, June 30, 1918. Low bidder, John S. Neff, Circleville, O., $22,099.27.

Roadway 27—Portage Co. on Sec. V of the Akron-Youngstown Road, in Edinburg Twp. For grading roadway, constructing bridges and culverts ($5,455) and paving with one of the following types:

Concrete. Width: Pavement, 12 ft. Roadway, 26 ft. Length, 13,682 ft., or 2.59 miles. Est. cost..... $46,932.43

Bituminous Macadam. Width: Pavement, 14 ft. Roadway, 26 ft. Length, 13,682 ft., or 2.59 miles. Est. cost 42,618.56

Monolithic Brick. Width: Pavement, 12 ft. Roadway, 26 ft. Length, 13,682 ft., or 2.59 miles. Est. cost 59,656.12

Date completion, June 15, 1918. Low bidder, L. Garrett, Kent, O. Concrete $46,841.55; monolithic brick, $59,640.37.

Road 28—Preble Co. on Sec. C-2 of the Hamilton-Eaton Road, in Gasper Twp. For grading, paving with bituminous macadam and constructing culverts ($100). Width of pavement, 16 ft. Roadway, 26 ft. Length, 2,800 ft., or 0.52 miles. Est. cost, $8,147.90. Date completion, Dec. 1, 1917. Low bidder, Hamilton & Bunger, Eldorado, O., $8,069.62.

Road 30—Ross Co. on Sec. N and n of the Chillicothe-Lancaster Road, in Green Twp. Contract No. 1: For grading roadway, constructing bridges and culverts ($170) and paving with semi-monolithic brick. Width of pavement, 13 and 16 ft. Roadway, 26 ft. Length, 3,489 ft., or 0.66 mile. Est. cost, $15,810.76. Contract No. 2: For grading roadway, constructing bridges and culverts ($549) and paving with semi-monolithic brick. Width of pavement, 3, 16, 30 and 50 ft. Roadway, 26, 40 and 60 ft. Length, 3,585 ft., or 0.68 mile. Est. cost, $28,848.83. Date completion, Dec. 15, 1917. Low bidder, Brewer, Tomlinson & Brewer, Chillicothe, O. Con. No. 1, $15,633.52. Con. No. 2, $28,538.66.

Road 31—Shelby Co. on Sec. B-1 of the Piqua-St. Marys Road, in Loramie Twp. For grading the roadway, constructing bridges and culverts ($513) and paving with one of the following types:

Brick. Width: Pavement, 16 ft. Roadway, 26 and 29 ft. Length, 4,960 ft., or 0.94 mile. Est. cost... $31,814.41

Monolithic Brick. Width: Pavement, 16 ft. Roadway, 26 ft. Length, 4,960 ft., or 0.94 mile. Est. cost 24,495.10

Reinforced Concrete. Width of pavement, 16 ft. Roadway, 26 ft. Length, 4,960 ft., or 0.94 mile. Est. cost 24,061.30

Date completion, Dec. 1, 1917. Low bidders: Edward Paul, Chas. L. Bozer and F. P. Elsass, Botkins, O., reinf. conc., $23,821.27. Isaac Putnam and Peter Shingledecker, Van Wert, O., reinf. conc., $23,193.70.

Road 32—Stark Co. on Sec. G of the Ravenna-Louisville Road, in Marlboro, Twp. For grading roadway, constructing bridges and culverts ($1,679) and paving with one of the following types:

Bituminous Macadam, Limestone Top Course. Width: Pavement, 16 ft. Roadway, 26 ft., or 2.52 miles. Est. cost..... $54,571.07

Bituminous Macadam, Slag Top Course. Width: Pavement, 16 ft. Roadway, 26 ft. Length, 13,300 ft., or 2.52 miles. Est. cost..... $54,571.07

Date completion, July 1, 1918. Low bidder, Seiple & Wolfe Construction Co., Youngstown, O. Bit. macadam, limestone top, $54,335.03.

Road 35—Union Co. on Sec. B of the Marysville-Kenton Road, in Paris Twp. For grading the roadway, constructing bridges and culverts ($1,734) and paving with waterbound macadam. Width of pavement, 16 ft. Roadway, 26 ft. Length, 15,231 ft., or 2.88 miles. Est. cost, $35,800.55. Date completion, 60 per cent. Dec. 1, 1917; 100 per cent. July 1, 1918. Low bidder, S. Baughman, Marysville, O., $33,506.61.

Road 39—Warren Co. on Sec. B of the Cincinnati-Chillicothe Road, in Harlan Twp. For grading, paving with waterbound macadam and constructing culverts ($2,852). Width of pavement, 14 ft. Length, 513 ft., or 0.10 mile. Est. cost, $3,793.70. Date completion, Nov. 15, 1917. Low bidder, Welden N. McKay, New Burlington, O., $3,789.

PERSONAL ITEMS

George M. Gadsby, formerly superintendent of the Arkansas Water Company at Little Rock, but who for several years was connected with the American Water Works and Electric Company of New York, has accepted a position as assistant to the superintendent of the company with which he is now connected. He is a graduate of the Massachusetts Institute of Technology and was at one time superintendent of the Warren Water Company at Warren, Pa.; the American Water Works and Guarantee Company at Pittsburgh, Pa.; the Arkansas Water Company at Little Rock, and the American Water Works and Electric Company at New York.

William H. Connell, former chief of the bureau of highways and street cleaning of the city of Philadelphia, has resigned that position to become engineer executive of Day & Zimmerman, Inc., Engineers, 611 Chestnut St., Philadelphia. The company will advise on engineering, administrative and financial problems connected with the construction and maintenance of roads and pavements, street cleaning and the removal and disposal of municipal waste.

Thomas A. Lowe of Buffalo, N. Y., superintending engineer for the Larkin & Sangster Company, causeway reconstruction contractors, has gone to Galveston, Texas, and is making preliminary plans for carrying out the work.

James C. Nagle has been appointed dean of engineering and professor of civil engineering of the Agricultural and Mechanical College of Texas, to succeed D. W. Spencer, who died in June. Dean Nagle is well known to civil engineers who have used his book on railroad location as a college and field text book.

W. B. Reed, formerly assistant city engineer of Roanoke, Va., has been named city manager of Portsmouth, Va., on a three-year contract, paying $4,000 for the first year, $4,500 for the second and $5,000 for the third.

M. L. Morris, former city engineer of Great Falls, Mont., has been appointed by the city council as superintendent of water works in that city at $250 a month.

Robert Elliott, for some years commissioner of water works in Nashville, Tenn., is up for re-election and his candidacy has been endorsed by the Nashville Real Estate Exchange.

Professor Milo S. Ketchum, dean of the College of Engineering of the University of Colorado, was elected superintendent of the Society for the Promotion of Engineering Education, at the recent annual meeting of the society. He is a graduate of the University of Illinois and was a member of the civil engineering faculty at that institution for a number of years. He is author of several well-known engineering text books.

E. N. Vail is in charge of the new offices of the New Jersey state highway department at Plainfield. This is headquarters of the northern division.

A. Baldwin Wood, an engineer of the sewerage and water board of the city of New Orleans, has been made consulting engineer of the sanitary district of Chicago and will hereafter serve both cities.

Caleb Mills Saville, for some years chief engineer of the water works at Hartford, Conn., has assumed the manager's duties as well. He has now under his charge all matters relating to engineering construction, extension, supervision, care and management of the water system. Formerly, for a period of ten years, he was division engineer of the Metropolitan water board of Massachusetts in Boston district, and for four years was engineer in charge of the third division on the Panama canal construction. His work at Panama was greatly admired by the engineering profession.

William Smith has been appointed city engineer of Jackson, Ky., succeeding Henry Dunneen.

George Wells has been appointed county engineer of highways for Pike county, Ky.

City Manager Frank J. Boland of San Rafael, Cal., has been given a captain's commission in the United States army engineering corps, and has reported for duty at the Presidio in San Francisco. On his return from military service he will resume his office of city manager of San Rafael.

C. C. Cottrell has been appointed assistant highway engineer of Nevada, with headquarters at Carson City.

Marvin E. Fawkes, for a number of years supervising engineer at the Columbia, Mo., water, light and heating plant, has resigned.

W. P. Near, city engineer of St. Catherines, Ontario, has been appointed manager of the city's gas plant.

Steel Hunter, for eight years engineer in charge of fire protection water works at Lucknow, Ontario, has resigned to take a position in Calumet, Mich.

Lieutenant Lewis Wynne-Roberts, formerly of Regina, Saskatchewan, and a son of the well-known consulting engineer, R. O. Wynne-Roberts, has been selected for duty in Mesopotamia, and left England last March, making the voyage down the west coast of Africa and spending a few weeks in Cape Town and other cities.

The following contracting firms are building or have recently completed army camps: Fred T. Ley & Co., Springfield, Mass.; Thompson, Starett Co., New York city; Irwin & Leighton, Philadelphia, Pa.; Smith, Hauser & MacIsaac, New York city; Rinehardt & Dennis, Charlottesville, Va.; Hardaway Constructing Co., Columbus, Ga.; Arthur Tufts Co., Atlanta, Ga.; A. Bentley Co., Toledo, Ohio; Mason & Hanger, Richmond, Ky.; Porter Bros., Detroit, Mich.; Bates & Rogers Construction Co., Chicago, Ill.; James Stewart & Co., New York city; Charles Weitz & Sons, Des Moines, Iowa; George A. Fuller Co., New York city; Stone & Webster Co., Boston, Mass.; Hurley Mason Co., Tacoma, Wash.; Consolidated Engineering Co., Baltimore, Md.; Fisk-Carter Construction Co., Greenville, S. C.; T. O. Brown Co., Augusta, Ga.; John O. Chisholm & Co.; Gallavan Building Co., Greenville, S. C.; W. Z. Williams, Macon, Ga.; Fred A. Jones Construction Co., Dallas, Texas; American Construction Co., Houston, Texas; J. W. Thompson Co., St. Louis, Mo.; Selden Breck Construction Co., St. Louis, Mo.; J. W. Thompson, Dallas, Texas; Algernon Blair, Montgomery, Ala.; T. S. Moody & Co., Chattanooga, Tenn.; Stewart McGhee Construction Co., Little Rock, Ark.; W. E. Hampton Co., Los Angeles, Cal., and The Lindgren Co., San Francisco, Cal.

The following officers are the construction quartermasters at the army training camps under construction or recently completed at the locations named: Captain Edward Canfield, Jr., Ayer, Mass.; Major O'Kelly Myers, Yaphank, L. I.; Harry O. Williams, Wrightstown, N. J; Major Ralph F. Proctor, Annapolis Junction Md.; Captain Edward, Petersburg, Va.; Major William Couper, Columbia, S. C.; Major James N. Pease, Atlanta, Ga.; Captain Ward Dabney, Chillicothe, Ohio; Major F. E. Lamphere, Louisville, Ky.; Major Earle B. Morden, Battle Creek, Mich.; Major D. H. Sawyer, Rockford, Ill.; Major John R. Fordyce, Little Rock, Ark.; Major M. A. Butler, Des Moines, Iowa; Captain J. F. Herman, Fort Riley, Kan.; Captain George E. Thorne, San Antonio, Texas; Captain D. L. Stone, American Lake, Wash.; Major C. H. Greene, Charlotte, N. C.; Lieutenant-Colonel J. D. Kilpatrick, Spartansburg, S. C.; Major Gratz B. Strickler, Augusta, Ga.; Major L. C. Dulin, Anniston, Ala.; Major A. G. Doyle, Greenville, S. C.; Major Walter Hernwood, Macon, Ga.; Major Hanson, Waco, Texas; Captain W. P. Roth-

rock, Houston, Texas; Major Charles H. Miller, Deming, N. M.; Major George D. Guyer, Fort Sill, Okla.; Major P. J. Vanzuben, Fort Worth, Texas; Major A. W. Reynolds, Montgomery, Ala.; Major W. J. Howard, Hattiesburg, Miss.; Major W. R. Goss, Alexandria, La.; First Lieutenant Charles Rogers, Linda Vista, Cal.

Andrew T. Hansen has been appointed city engineer of Los Angeles, to succeed Homer Hamlin. He is a graduate of the University of California and was formerly an engineer on the United States reclamation service. Since 1906 he has been in the engineering department of Los Angeles, serving as chief deputy of the city engineer since 1913.

W. H. Schwartz has been appointed city engineer of Vancouver, Wash. Formerly he was county engineer of Clark county in that state.

Professor George C. Whipple, head of the sanitary engineering department of Harvard University and a member of the engineering firm of Hazen, Whipple & Fuller of New York city, recently went to Russia as a member of the American Red Cross mission. He is well known for his writings on sanitation and for his reports and contributions to technical literature.

A. E. Berry is sanitary engineer with the Ontario provincial board of health at the Toronto experiment station. He was formerly associated with James, Louden & Hertzberg, consulting engineers of Toronto.

E. R. Gray has been appointed city engineer of Hamilton, Ontario, in charge of water works and sewage treatment plant. He was formerly deputy city engineer of the same city.

John Neeham has been appointed city engineer of Burlington, Wash.

S. G. Swigart has closed his office at Missoula, Mont., and has re-established his consulting civil engineering and hydraulical engineering practice at Akron, Ohio.

John W. Alvord, C. E., of the firm of Alvord & Burdick, consulting engineers, Chicago, has been appointed by Governor Lowden of Illinois as a member of the Illinois state board of natural resources and conservation. He is to advise on water resources. There are four other members of the board, specializing in geology, biology, chemistry and forestry, respectively. The board is appointed under the new civil administrative act and is expected to study the resources of the state, the work of its departments under the lines indicated and advise the governor and the legislature from time to time on matters in which the welfare of the state may be promoted. The members of the board serve without compensation.

George B. Post & Sons, architects, and Ernest P. Goodrich, engineer, announce that they have become associated professionally in the practice of architecture, engineering and city planning. The architects' office is at 101 Park Ave., and the engineers' office at 261 Broadway, New York city.

Calvin W. Hendrick has resigned as chief engineer of the city of Baltimore.

COMING CONVENTIONS

NATIONAL ASSOCIATION OF PURCHASING AGENTS—Annual congress at Pittsburgh, Pa., Oct. 9-11. Permanent headquarters, 600 Westinghouse Bldg., Pittsburgh.

LEAGUE OF KANSAS MUNICIPALITIES—Annual convention at Wichita, Kans., Oct. 9-11. Sec'y, C. H. Talbot, University of Kansas, Lawrence.

LEAGUE OF MINNESOTA MUNICIPALITIES—Annual convention at St. Cloud, Oct. 17-18. Sec'y, Richard R. Price, University of Minnesota, Minneapolis.

OKLAHOMA SOCIETY OF ENGINEERS—Annual convention at Oklahoma City, Oct. 29-30. Sec'y-Treas., Horace V. Hinckley, Oklahoma City.

CITY MANAGERS' ASSOCIATION—Annual meeting at Detroit, Nov. 19-24. Sec'y, W. L. Miller, City Manager, St. Augustine, Fla.

VIRGINIA GOOD ROADS ASSOCIATION—Annual convention at Richmond, Jan. 15-17, 1918. Sec'y, C. B. Scott, Richmond.

FIRST CHICAGO CEMENT MACHINERY AND BUILDING MATERIAL SHOW—Supersedes annual Chicago Cement Show. To be held under auspices of the National Exhibition Co., 123 W. Madison St., at the Coliseum, Feb. 6-13, 1918.

OBITUARIES

James Peter Beck

On Saturday, September 8, James P. Beck died at the Presbyterian hospital, Chicago. At the time of his death he was general manager of the Portland Cement Association, with headquarters at 111 W. Washington St., Chicago. Mr. Beck was a little past 31 years of age.

He was graduated from the University of Illinois in 1907 with the degree A. B. in L. & A. On his graduation he entered the employ of the Universal Portland Cement Company. Two years later he was made publicity manager of that company by Edward M. Hagar, then president of the Universal Portland Cement Company. A little story in connection with this promotion to so responsible a position gives an insight into the business ability of the man who was taken away while yet almost youthful. Edward M. Hagar, it will be remembered, was the father of the Cement Products Exhibition Company, and while one of the cement shows was being planned became too ill to attend to details and transferred the responsibility to Mr. Beck with the remark, "Well, see what you can do with it." What Mr. Beck did on this occasion and on the numerous others which followed while he was identified with the Cement Products Exhibition Company are too well known to need comment. His first as well as following efforts to make the Cement Products Exhibition Company a success were noteworthy. Mr. Beck was also a prime mover in the two national conferences which were held in Chicago known as the national conference on concrete road building.

During his term at college he was editor and manager of the Illio, the Junior Annual, and manager of the Illinois Magazine. He was captain and regimental adjutant of the cadet regiment at the university and was president of the Illini Club, Chicago, for one year. He was a member of a number of clubs, associations and fraternities.

During the fall of 1915 Mr. Beck was chosen to formulate plans for broadening the scope of work of the Association of American Portland Cement Manufacturers, the headquarters of which were then in Philadelphia. After several months' work, he submitted at the annual meeting of the association in December, 1915, a very comprehensive plan which was adopted essentially in its entirety. Mr. Beck was then made general manager of the association to put into effect and carry out the plan which he formulated. How successful this has been is known to every one whose interests have kept them in touch with the rapid developments of the cement industry and the work of the Portland Cement Association during the past two years.

TRADE NOTES

Andrew Langenbacher has been appointed sales manager of the Duplex Truck Company of Lansing, Mich. He was formerly in charge of exports, as well as a sales division of the Reo Motor Car Company, and has a wide acquaintance among automobile distributors in this and foreign countries. He expects to double the dealer organization of the Duplex Company at once.

Mr. Austin, chief engineer of the Gramm-Bernstein Motor Truck Company of Lima, Ohio, who was chosen from among the leading truck engineers of the United States by Captain Britton of the United States army who has charge of the laying out of the standardized army chassis, is now in Washington working every day upon the plan for this standardized army motor truck.

A large number of orders for Packard Twin Sixes of the third series have been received from the Hawaiian Islands, Cuba, China, Spain, Brazil and Argentina, despite the fact that excepting in Cuba and Brazil, even the dealers have not seen the new cars. The sales have been made on the "Packard" reputation and the descriptive literature that has been sent out. The policy of the Packard company on foreign business seems to have taken well all around.

All the property as a going business concern of the Blaw Steel Construction Company and of the Knox Pressed and Welded Steel Company, respectively, have been consolidated and merged into the Blaw-Knox Company, and all property and business of each of the former companies will hereafter be transacted by the Blaw-Knox Company, which has taken over all contracts, has acquired all current accounts and is prepared to meet all outstanding obligations of the Blaw Steel Construction Company and the Knox Pressed and Welded Steel Company, respectively, when due. All unfinished contracts of each of the former companies will be carried out and performed by the Blaw-Knox Company without interruption. All payments will be made from the office of the Blaw-Knox Company at Hoboken, Pa., and checks for accounts due the Blaw Steel Construction Company and the Knox Pressed and Welded Steel Company should be drawn to the order of the Blaw-Knox Company and mailed to Blaw-Knox Company, P. O. Box 915, Pittsburgh, Pa.

The Ransome Concrete Machinery Company of New Jersey has just been incorporated to take over the business and plants of the Ransome Concrete Machinery Company of New York. The latter company has been successfully engaged in business for over twenty-five years. Increases in business and the necessity of covering a very large export field has made necessary the bringing in of new and larger capital. The new company has a capital of $1,000,000, $500,000 in 7 per cent cumulative preferred stock and $500,000 in common stock. The new company is to be enlarged in its capacity of production so that it will cover the entire field of contractors' equipment in concrete machinery and the road builders' requirements of all kinds. Its road pavers are being used largely all over this country and its pneumatic machinery is finding use wherever large masses of concrete are wanted and rapid mix and quick delivery is a requisite. The New York and the Brooklyn subways were built with the Ransome-Canniff pneumatic mixers.

On account of the increasing demand for Texaco Asphalt in all parts of the United States, the Texas Company this year has doubled the capacity of its plant in Port Neches, Texas, making it the largest refined asphalt plant in the world, and has also built large exclusively asphalt refineries in Norfolk, Va., Providence, R. I., and Marcus Hook, Pa. Texas, of course, uses only a very small per cent of the output of these refineries, for there are many eastern cities that each lay more pavements per year than the whole state of Texas does, and all contractors who are acquainted with paving conditions outside of the state know that Texaco is a factor in every letting.

The Federal Motor Truck Company announces the election of W. C. Rowley, for some time a member of the board of directors, to vice president in charge of sales, succeeding J. F. Bowman, resigned. Mr. Rowley assumed his new duties on August 16. He has been connected, in various capacities, with the Michigan Central Railroad for thirty-two years. He began his railroad career as agent for the fast freight lines of the M. C. Ten years later he became general agent, continuing in this capacity for two years, when he was advanced to assistant general freight agent at Bay City. In 1903 Mr. Rowley became general freight agent at Detroit, from which position he resigned to take up his duties with the Federal Motor Truck Company.

Improving Road Drainage With Dynamite

There was a section of road in Chester county, Pennsylvania, which caused trouble for a long time by remaining water-soaked after heavy rains. The side ditches were laid out properly and had good outlets into neighboring brooks, but the roadbed was not drained satisfactorily by them. This roadbed was well consolidated and it was considered undesirable to dig it up to permit the installation of cross-drains in it if another remedy could be found. It was finally decided to bore holes in the bottom of one of the ditches and loosen the material in the bottom of these holes by exploding light charges of dynamite there. This is a very old practice for increasing the flow of oil and water from deep wells, and worked very satisfactorily on the road in question. The bottoms of the holes were in shale, which was so loosened by the blast that this deep-lying material was provided with a number of cisterns or chambers, into which the water in the roadbed drained freely after each rain. This remedy was provided at far less cost than the installation of cross-drains would involve and the road was kept intact.

A Roller for Finishing Concrete Roads and Pavements

Prominent highway engineers have endorsed the Macon concrete paving roller, as originated by Captain J. J. Gaillard, city engineer of Macon, Ga. Rollers of this type are being manufactured and marketed by the Ransome Concrete Machinery Company. For ease in manipulating concrete it is necessary to use a little more water in the concrete mixture than is required for the maximum strength of the concrete. With the roller method of finishing much of the excess water is removed from the concrete in the process of rolling, while at the same time the concrete is considerably compacted. The effect of the roller has been characterized as that of a rolling squeegee. It takes out the slight uneven places in the surface which may be present if a template is used in striking off the pavement surface. Rolling continues until the free water no longer comes to the surface. Tests indicate that rolled concrete is 20 per cent stronger than hand finished concrete.

The roller is equipped with a long handle and the operator stands clear of the green concrete. The roller is demountable and weighs 102 lbs. gross. The bearing weight on the road is 85 lbs. The roller is 10 ins. in diameter and 72 ins. long. The device is collapsible and easily shipped. This is one of those small adjuncts to practical road building that jumped into favor with contractors and engineers.